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USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

NEW PRODUCT LINE OF KIEV MACHINE TOOL BUILDER VIEWED

Moscow MASHINOSTROITEL in Russian No 4, Apr 85 pp 44-45

[Article by I.S. Vitol: "At the USSR Exhibition of the Achievements of the national Economy: Innovations of the Kiev Machine Tool Builders"]

[Text] The Kiev Automated Machine Tool Factory imeni M. Gorkiy is the chief plant of the Kiev Machine Tool Association. The Kiev Machine Tool Association was founded during the second five-year period. Since then, the association has grown considerably and taken one of the leading places in Soviet industry. The plant's shops manufacture multispindle automated and semiautomated lathes and automated lines. All of the plants in the USSR that produce bearings, automobiles and agricultural machinery use machinery made by this plant. Aside from the demand they receive in the USSR, these machines are exported to more than 30 countries worldwide. At many international exhibitions, this equipment has been praised as accurate, reliable, economical and fast.

The new equipment currently produced by the plant is technologically very versatile and is more precise and faster than the earlier models. The use of this machinery in the national economy can replace 24,000 workers and produce a savings of 50 million rubles. For its achievements in All-Union socialist competition, the plant was awarded the intermittent Red Banner of the CPSU Central Committee, the Council of Ministers of the USSR, the All-Union Central Council of Trade Unions and the Central Committee of the All-Union Lenin Communist Youth Union. The Kiev Machine Tool Association displayed its achievements at the machine building pavilion of the USSR Exhibit of the Achievements of the National Economy.

For automation of loading and transport work in lathe-working of pinions of up to 189 mm in diameter, the plant manufactured the LK-140 automated line. It consists of four KA-378 model 6-spindle automatic lathes with built-in automatic manipulators, hydraulic and mechanical chip-crushing systems forced cutting tool replacement. Two of the automated lathes machine the hole and the base face of the pinion while the other two work the outer diameter and other face. After the inner diameter of the pinion is machined, the hole is automatically monitored in monitoring and blocking devices.

The line's transport system provides flexible travel between units. It consists of a hopper, hoist, interoperation storage and gravitational chutes

with supports. The transport system can be shut down automatically by its control system. Manipulators are used to load blanks into the machine chuck and finished parts are released into the discharge chute which takes them to the monitoring and blocking device. Five "TESLA" (Czechoslovakia) programmable controllers are used as the line's control system.

The line can turn out 221,000 parts per year and its dimensions are 13,500 x 11,500 x 54,300 mm. Its use can save 142,000 rubles per year.

The KA-238 semiautomatic 8-spindle horizontal lathe is designed to turn parts (custom-made blanks from forging, casting, stamping and cutting of rolled stock) made from various grades of steel, pig-iron or nonferrous metals and to perform operations requiring that the spindle be held at a fixed angle to the part worked. It can also be used for rough, finished, and form turning, undercutting of faces, grooving, drilling, boring, reaming, cutting, form rolling, and threading, rolling of riffles, etc. An automatic loader allows the lathe to be built into automated lines. The annual savings from its use amounts to 5,480 rubles.

Technical Characteristics

Maximum chuck diameter, mm..........150

Spindle rpm..........97-814

Cycle duration, min..........0.1-6.1

Electrical motor capacity, kW..........43

Lathe dimensions, mm..........3835 x 1910 x 2610

The KA-195 special automated 6-spindle horizontal lathe was based on the 1B216-6K automated bar lathe and designed to work custom blanks from two sides with repositioning during the processing. It has four working positions and can simultaneously turn undercut, and cut external threads. The lathe is equipped with a hopper for directional blank feeding and a manipulator to load blanks and reposition semi-finished parts. It provides very high-quality machining thanks to the highly precise manufacturing of the spindle drum and the longitudinal and lateral carriages. The use of this lathe can save 6500 rubles per year.

Technical Characteristics

Maximum diameter of machined blank, mm..........16

Output, units/hour..........760

Main electrical drive capacity, kW..........11

Dimensions, mm..........3850 x 1650 x 2600

The Kiev Machine Tool Association along with the USSR Academy of Sciences Institute of Electrical Welding imeni Y.O. Paton has introduced a process for reconditioning of machine parts with a microplasma welder on an MPU-4 unit which is designed for manual welding of parts made of iron, nonferrous, light and refractory metals and alloys of small thickness (from 0.1 to 1.5 mm depending on the physical and chemical properties of the welded metals and the type of weld used). The power source and plasma generator form argon plasma jets into needles which makes it possible to make narrow welds with a small zone of thermal effects and little deformation of the welded metal surface. Argon is used as the plasma gas and the protective gas is argon, helium, carbon dioxide or a mixture with hydrogen.

The stability and stable burning of the arc makes it possible whenever necessary to introduce additives into the arc combustion zone and therefore give the weld the needed physical and chemical properties. Thus, the use of powdered PP-AM148 wire as the additive material immediately after welding will give the weld a hardness of NRS 60. This is very important in reconditioning of crucial parts (such as cemented parts or those machined to class 1 or 2 precision) since it makes it possible to dispense with secondary thermal or chemical and thermal treatment. The annual savings from the use of this process in the microplasma welders of the Kiev Machine Tool Association was 12,000 rubles.

Together with the USSR Academy of Sciences Institute of Superhard Materials, the association has introduced an advanced process for abrasive deep grinding of threads. This process simultaneously works their main rear surfaces, the chip-breaking element the chamfering on the forward surface. The grinding is done on a modernized 3B642 universal sharpener with three abrasive discs on a metallic bond using a lubricating and cooling liquid. The sharpener comes with: a universal attachment for sharpening the forward and rear surfaces of the tool, chip-breaking grooves and mandrels for attachment of two discs; AChK [not further identified] forms for sharpening the rear surface and an A5P (APP) form for sharpening the chip-breaking element; attachment for sharpening the forward surface; attachment for regulating the height of cutter movement and the sharpening of the auxiliary rear surface; special tank for feeding and suctioning off of the lubricating and cooling fluid as well as jacket to prevent splashing. The use of this process can increase worker productivity 150 to 200 percent, improve the quality of precision sharpening of cutters and reduce labor by 40-50 percent. The annual savings from the introduction of this process amounts to 15,000 rubles.

A result of cooperation between the plant and the institute has been the introduction of a process for deep abrasive sharpening of hard-alloy tools. This process makes it possible to considerably improve the quality of tools and to increase worker productivity and the level of production. It can be used to sharpen hard-alloy plates of up to 8 mm thickness with a grinding depth of up to 1 mm per pass. The surface roughness of the machined part falls within classes 8-9. Sharpening is done at the institute by a ZAG-2M abrasive cup-type discs on M013 and MV1 metallic bonds. This process can produce a yearly savings of 26,200 rubles.

The KA-371 6-spindle horizontal automated bar lathe is based on the 1B265-6K series-produced automatic lathe for machining parts made from calibrated bars or tubes of up to 65 mm diameter. This lathe can perform rough, finish and form lathing, undercutting, centering, drilling, counterboring, reaming, thread cutting, knurling, cutting, and other operations. Its high output, wide technological possibilities, reliability and sturdiness make this a useful tool for plants building agricultural machinery, automobiles, tractors, etc. In the working space on the planes of the longitudinal and the 6 lateral carriages can be placed a large number of attachments necessary for machining complicated parts.

The strength of the lateral carriages and other structural elements increases the accuracy of machining and in many cases this makes subsequent surface cleaning by other machines unnecessary. The mechanized loader makes the loading of bar blanks less time-consuming, reduces the amount of time spent on auxiliary operations and saves up to 8 m^3 of work space. The positioning of the loader allows it to hold enough bar blanks for one full work shift. A programmable controller governs the lathe.

Technical Characteristics

Maximum diameter of machined bar, mm....65

Maximum length of bar blank, mm....4000

Maximum length of material feed, mm....200

Maximum thread diameter, mm:

in steel....36

in brass....42

Dimensions, mm....8060 x 2060 x 2170

The Kiev Machine Tool Association is manufacturing shaped molten-slag electrically cast blanks for the longitudinal carriage and plates of the carriage group of multispindle automated machines without any preceding pressure treatment. The blanks are produced in the form of short copper ingots with a working part profile matching that of the blank. The hole is formed by a mandrel of the proper diameter. During its manufacturing, the cast blank moves continuously in relation to the ingot and mandrel. Its length is determined by the technical possibilities of the electric-slag unit (up to 1350 mm) and this makes it possible to make several parts from one blank.

The 001-010-0064-7752 device for undercutting both sides of ring faces after they have been cut out consists of a counterspindle and a tool carriage with two undercutters. The counterspindle is set in its working position onto the longitudinal carriage and is moved by a drive with an independent power source. The tool carriage comes into motion once the ring is cut off during the movement of the device away from the spindle. To cut out pipe blanks,

disc knives can be used and this conserves material, increases productivity and does away with more operations on other machines. The maximum working movement of the cutters is 20 mm.

The 001-046-0064-7735 device for machining external spherical surfaces of different diameters is attached to the lateral carriage of the machines. The spindle can turn up to 120° away from the independently-powered drive.

The 001-010-0064-7722 device for machining the inner surfaces of grooves and undercutting faces in holes is made from right-angle guides. It is set onto the longitudinal carriage of a multispindle lathe. The tool is pushed laterally away from the lateral carriage. The maximum cutting width is 10 mm and the maximum working movement is 42 mm.

The 001-011-0064-7524 device is designed for boring shaped surfaces and forming of various grooves by incision on multispindle automatic lathes. The incision of the tool is done by converting (with the help of a wedge mechanism) the longitudinal movement of the carriage to which this is attached to the lateral movement of the tool.

It is highly reliable sturdy and simple to operate. Its efficient arrangement and original construction have reduced its size and metal content and increased its technological possibilities. The use of interchangeable cutting units in which the cutting tool is protrudes to the dimension outside of the machine lowers costs per shift and regulation by 20-30 percent. The maximum cutting width is 45 mm. The maximum lateral movement is 10 mm.

The 001-001-0000-7513 device for multipass cutting of outer and inner threads and screw grooves can cut left or right threads, mono- and multi-start threads, cylindrical and conical threads of various pitches and profiles, bort [industrial diamond] threading, threads without grooves for tool entry or exit and remove incomplete turns in the starting and ending parts of threads. It is very reliable, sturdy and simple to operate. The possibility of advancing the tool along the side of the turn makes it possible to increase output by 15-20 percent. Its efficient arrangement and original construction of the mechanisms for turning the tool on and off make it possible to reduce the drive load and thus provide more accurate work. The threading diameter is 20-240 mm and threading depth is 5 mm. At its greatest lateral movement, the number of the tool's second passes is 120 per minute.

12261
CSO: 1823/156

GROWING DEMAND FOR QUALITY CUTTING TOOLS NOT MET

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 3 Apr 85 p 1

[Article by V. Vasilyeva, assistant editor, Machinebuilding and New Technology Department, under the rubric "Economic Review": "General-Purpose Cutting Tools"]

[Text] The board of the Ministry for the Machine Tool Industry was discussing an extraordinary event: the Sestroretskiy Plant, which manufactures the most up-to-date tools out of superhard alloys, had a surplus of finished goods: customers were rejecting its products. As it turned out, it was not the only factory in that situation. Over twenty million rubles worth of similar tools piled up last year in the warehouses of the USSR State Committee for Material and Technical Supply. Finally, supply offices virtually had to force their distribution among the ministries, which in turn passed them on to enterprises.

Now consider this fact: the Kolomenskiy Heavy Machine-Tool Plant has developed and implemented production of up-to-date lathes for machining crankshafts with a female mill [okhvatyvayushaya freza], which are in high-demand, especially in the tractor and automotive industry. But for the last several years, these lathes have not had a market: no tools are designed for them.

What do these facts, at first glance seemingly unrelated, indicate? First, that both tool and equipment efficiency is directly proportional to how smoothly they function together in production in terms of quantity, quality and applicability. In the first instance, surpluses piled up largely because the tools were not designed for existing equipment and they required higher quality machines: higher RPM and higher vibration ratings.

But this case, where the tools are more advanced than the machines that use them, is not typical.

On the whole, we are forced to admit that at the present time, the pace of tool production and the technical quality of tools are inferior to those of the machine building industry and lag considerably behind today's demand. This lag is being felt particularly acutely now at a time when the production of modern machines has greatly increased: numerically controlled machines, work centers and automated lines. The order of the day calls for the development and broad application of flexible automated production. With the arrival of this high-cost, highly productive equipment, which will be the infrastructure for unmanned and lightly manned technologies, the importance of tools increases. In

order "to turn off the lights in the shop," as the specialists say, there is a need not only for more reliable, longer-life cutters, drills and milling lathes: related problems such as shaping and removing chips, machining process control, tool diagnostics and automatic tool change-out must also be resolved. Finally, it is necessary to organize the manufacture of precision accessories for mounting cutters, which also become quite important in automated production.

Who should perform these tasks? It should be said that the search for optimal designs is now going on at scientific research and design organizations in several sectors. At the Ministry of Instrument Making, Automation Equipment and Control Systems, for example, efforts are concentrated at the Rizhskiy Central Planning and Design Office for Mechanization and Automation; at the Ministry of Tractor and Agricultural Machine Building, the Tekhnolog Scientific Production Association in Tashkent and the Spetstekhosnastka Scientific Production Association in Odessa are involved; and in the automotive industry, specialists at the Scientific Research Institute of Automotive Industry Technology are working on the problem. But the main entity involved, as is well-known, is the Ministry of the Machine Tool and Tool Building Industry. This ministry has been mandated to set technical policy and provide the national economy with tools. Logically, it provides the coordination so critical nowadays between the production of modern equipment and tools for that equipment.

But the situation has become so complex that only about a third of all tools made in the country are being manufactured at this ministry's plants. The remainder, mostly special tools, are being made by machine builders themselves.

Here it should be stressed that since this situation began some time ago, large, specialized shops and even factories in some sectors have sprung up at large production associations such as the automotive and tractor giants. These shops turn out fairly high-quality products and to a certain extent, they meet the demands of the sector. But alongside these shops, there is an enormous number of quite small tool-making shops in the country, which turn out very low-quality products at high material and labor costs. Why can we not eliminate these now? Because the Ministry of the Machine Tool and Tool Building Industry is not meeting the demand for standard tools, not to mention specialized tools. And this situation exists while its facilities, according to the admission of A. Derzhavin, director of the Soyuzinstrument All-Union Production Association, are working at only 87 percent of capacity.

"It's all a matter of shortages of material resources," explains Andrei Viktorovich. "If other ministries would transfer their allocations for hard-alloy materials to us, we could greatly increase production of cutters and milling cutters with mechanized mountings for faceted disposable blades."

Increasing production of these tools is an urgent present-day problem. In the first place, the tools are highly practical on the job: when one cutting face becomes dull, the blade is simply rotated to continue machining the part. This is especially important for numerically controlled machines and work centers. Secondly, unlike welded cutters, these cutters make it possible to reuse up to 90 percent of hard alloys. Thus, as production of the compound tool increases,

material shortages are alleviated. But breaking this vicious circle is not simple, particularly since the ministries holding allocations for hard alloys are not about to give up their funds for the Ministry of the Machine Tool and Tool Building Industry.

"We would be glad to reduce our tool production and transfer funds to the Ministry of the Machine Tool and Tool Building Industry," automotive workers explain. "But what guarantee is there that we would receive the tools we need in return?"

The Soyuzinstrument All-Union Production Association cannot make that guarantee. The fact is that specialized mass production at its factories is geared toward general-purpose users. In fact, its customer is the USSR State Committee for Material and Technical Supply. The entire tool output of the factories under the Ministry of the Machine Tool and Tool Building Industry flows into this Committee's regional warehouses, which distribute the tools to enterprises. This is a convenient system for the tool-making factories: it enables them to meet their production plans comfortably. But what about the user enterprises? Reality shows that not all tools received can be used, while they are forced to make other tools themselves. Although tool factories manufacture a wide range of tool products running to as many as 800 types and sizes, their isolation from customers leads to serious distortions. Surpluses of one tool periodically accumulate in warehouses, while shortages of others are noted. But this is not discussed at all at the tool factories themselves.

There is such a thing as a tool and accessory factor. In world-wide practice, the value of all the accessories and tools on metalworking equipment comes to 30-40 percent of the cost of the equipment. Only a few machine-tool building enterprises in our country meet that level, e.g., the Red Proletariat and the Ivanovskoye 50th Anniversary of the USSR Association. The Ministry of the Machine Tool and Tool Building Industry has never once been given the task of supplying standard sets of cutting tools for the numerically controlled lathes, lathe complexes and automated lines now being delivered. To this day, the customers themselves are forced to face the problem. In addition, this frees equipment makers from unconditional liability for their products, allowing them to blame any defects on the quality of the tools, which in fact is often poor.

As far as numerically controlled lathes are concerned, a set of tools has been developed, but again they are intended for the general-purpose user. Until special tools are available, machine builders must complement these tools with their own.

This is why machine builders do not risk giving up their allocations for tool materials. Relying more and more on themselves, they are increasing their own production of tools considerably. For example, at the Ministry of Tractor and Agricultural Machine Building, at the end of the 12th Five-Year Plan, a 2.5 percent increase is planned. The annual increase in this area is 10-12 percent, while at Soyuzinstrument it is 5-7 percent.

That is a telling fact. Five years ago, the Ministry of the Machine Tool and Tool Building Industry was satisfying 20 percent of the automotive industry's

demand for standard tools, but today it is meeting only 14 percent of that demand. During the same period of time, that sector took increasing deliveries of numerically controlled machines, automated lines and work centers, and basically the burden of tooling the machines fell on the automotive workers.

To a large extent, further development in machine and machine-tool building depends on progress toward solving the tool problem. It is abundantly clear that the most pressing demand of the day is to accelerate the pace of development of specialized tools. And in order to do so, a clearer understanding of actual demand is needed, by tool and specific types of tools, as well as readjustment of production accordingly. This is especially important now, because a basic structural change in tool production must be made in the next few years to ensure the advance production of highly efficient, economic tool designs.

8844
CSO: 1823/123

UPGRADED TURBINE BLADE PRODUCTION SYSTEM SHOWN

Moscow EKONOMICHESKAYA GAZETA in Russian No 23, Jun 85 p 1

[Unsigned article with photograph by V. Samoylov: "Leningrad Turbine Blade Plant Production Association"]

Set-up engineer A. Shindrov is shown machining turbine blades.

[Text] Labor productivity at the Leningrad Turbine Blade Plant Association is increasing at a fast pace. In 4 years productivity has increased by 42.8 percent, compared to a plan of 40.5 percent. The basis of this labor-productivity growth was the realization of an integrated plan for production equipment replacement.

The collective has now begun a competition in honor of the 27th CPSU Congress. The machine builders are striving to reach the labor productivity level stipulated in the 5-year plan ahead of schedule, by 1 October 1985.

12595
CSO: 1823/169

OTHER METALWORKING EQUIPMENT

UDC 621.979.065:624.4-691.32

DESIGN FEATURES OF LARGE FORGE PRESS VIEWED

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 4, Apr 84 pp 10-13

[Article by I.G. Lyudovsky and M.I. Brailovsky: "Forge presses with ferroconcrete base parts"]

[Text] One means for effectively reducing the amount of metal in forge presses is to use nonmetallic materials and especially prestressed concrete.

The use of ferroconcrete structures to manufacture of forge presses has been studied since 1959 by the Science Research Institute of Ferroconcrete and Concrete of the USSR Construction Ministry and the All-Union Science Research Institute of Metal Machinery. At this time, these institutes and many factories and industrial organizations carried out large-scale studies, developed design solutions and created various machines with forces of up to 50 MN (see table).

Experience has shown that the use of prestressed ferroconcrete in forge presses can save a considerable amount of metal and also lower costs and labor.

At the present time, concrete can be made which is capable of withstanding pressures of up to 100-120 MPa and is also, due to its high structural strength and density more resistant to the effects of dynamic loads and destructive agents (such as oils, emulsions, etc.).

The use of ferroconcrete structures for forge presses makes it possible to sharply reduce the metal content (by as much as 65-85 percent) without significantly changing size or weight (especially of the cast metallic elements of the base, to lower the labor-intensiveness of manufacture (by 45-60 percent) and more quickly manufacture these machines.

Ferroconcrete not only does not adversely affect the basic technical characteristics of equipment but in many cases makes it possible to produce much stronger forge presses. This is due to the fact that the use of ferroconcrete composite structures makes it possible to regulate the structure's starting modulus of inelastic buckling, increasing it in

comparison to the modulus of elasticity of unreinforced concrete by 1.5-2.5 times and practically reducing it to the value of the modulus of elasticity of gray cast iron. At the same time, the pressure differential in a ferroconcrete structure under operating loads is 2-3 times lower tnan in in metallic bases (40-60 MPa in the reinforcement of ferroconcrete frames and as much as 150-180 MPa in metallic column frames).

Because a single value of stresses (10-20 percent of average stresses) is achieved under a repeating operating load in prestressed ferroconcrete elements of forge presses, the service life of the structure is practically unlimited.

In most cases, the structural forms of ferroconcrete bases can be simplified in comparison to metal bases. This significantly improves the technology of manufacturing the elements and reduces their overall amount of metal working and labor involved.

If in the metal elements of the base (especially the castings), any deviation from nominal dimensions reaches ± 0.2-0.6 percent, then in ferroconcrete elements the machining allowance can be lowered 3-5 times since the ferroconcrete shrinkage is 0.015-0.03 mm/m and additional distortion of the form is excluded by special technological precautions such as preliminary machining of the component parts and their precise placement in fixed places. Subsequent machining of the entire base is no longer necessary.

Two types of ferroconcrete bases have become the most widely-used: those with crossbars in the form of continuous cylinders with round or elliptical cross-sections set on the same plane and those with crossbars in the form of round or parabolic semidiscs.

The crossbars rest against columns made from pipe and concrete elements and are joined by the working tendons into a rigid spacing frame that absorbs the pressing force. The tendons of the bases with cylindrical crossbars are manufactured from reinforcement rods that pass through the cross section of the columns and crossbars while the tendons with semidiscs are in the form of stressed closed belts placed along the inner course and assembled from multi-layered high-strength cold-drawn reinforcing wire of 5 mm diameter.

In 10 years of operation (since 1973) of a 40 MN press at the Bolshevo Machine Factory (figure 1), more than 10 million heat-exchange plates have been made and in its first three months of operation, the press paid itself off.

Presses are being successfully operated that have ferroconcrete bases and elliptical crossbars in the same plane, which is more convenient when the space between stamps is increased, are being successfully operated. Figure 2 shows a press with such frames which is used to press parts from powdered materials. This press is being operated at the Red Giant plant in Nikolsk.

Technical Characteristics of the Press

Force, MN..50

External dimensions of the frame with elliptical crossbars in the same plane, mm:

along the major axis...3800
along the minor axis...2800
height..9200

Dimensions of the stamping space, mm:

level dimensions..2200 x 2500
height..2500

Effective strength, N/mm..7.4

An inserted metal cylinder withstands pressures of up to 50 MPa.

Three units have been manufactured to calibrate the force cells of stands of 20 and 25 MN rolling mills (figure 3) with elliptical crossbars in the same plane.

Technical Characteristics of Force Cell Calibrators

Force, MN..25

Frame dimensions, mm:

level dimensions..2485 x 1845
height..5086

Dimensions of the space between stamps, mm:

level dimensions..1300 x 1270
height..2350

Effective strength, MN/mm..18

An inserted metal loading device withstood pressures of 120 MPa.

An example of the use of structures with crossbars in the form of semidiscs of round and parabolic contours is the double-action hydraulic press created by the All-Union Science Research Institute of Metal Machinery and the Science Research Institute of Ferroconcrete and Concrete for pressing hard-alloy heat-resistant materials and powders.

Technical Characteristics

Force, MN..30

Frame dimensions, mm:

level dimensions..2200 x 1150
height...700

Dimensions of the space between stamps, mm:

level dimensions..1200 x 1150
height...600

Effective strength. MN/mm...8

Aside from hydraulic presses, prestressed bases have been manufactured for mechanical presses that operate under more difficult conditions than those of hydraulic presses.

The Science Research Institute of Ferroconcrete and Concrete has manufactured frames for two K-117B and K-2130B crankshaft presses used for cold stamping. These presses have a force of 10 kN with a load frequency of 80-120 working passes per minute. They have open single-frame bases.

In tests conducted after 2.5 million load cycles, there was no observed deterioration of performance. However, at any greater number of cycles, the base strength was diminished because double- and triple-axis prestressing was not technologically possible.

Experience in operating these presses has shown that there is no way that the metal frames can be mechanically replaced by ferroconcrete ones.

Theoretical and experimental studies as well as operating experience have shown the best design features for heavily-loaded press elements such as frame crossbars and columns as well as individual components and parts (the stamping units, power cylinders, etc.). All of these elements are manufactured prestressed by volume in order to increase their strength and elasticity.

The round and elliptical crossbars on the same plane in cylindrical frames function under conditions of a complex stressed state. In order to ensure their ability to work under stress levels considerably exceeding the strength of their grade of metal, they are reinforced by a spacing frame that has steel plates along its ends. These plates are connected by vertical rods or pipes. A frame of this sort considerably increases the strength and amount of load the crossbars can support and helps to distribute concentrated forces. Its chief advantage is that with the winding of rods along the perimeter of a spiral prestressed reinforcement, the effect of a triple-axis stress is produced since any vertical elongation is prevented by the vertical rods. Therefore, the limitation of lateral deformations creates not a two-axis but a three-axis prestress.

A characteristic feature of the work of massive prestressed ferroconcrete crossbars is that local deformations (such as those under the stamp) do not affect the overall strength and elastic work of the element as a whole. The concrete beneath the stamp is always under volumetric pressure and this sharply increases its strength and elasticity. Therefore the profile of contact stresses under the stamp are smoother and the maximum stresses are half the theoretical stresses calculated for elastic material.

Research has shown that under normal ratio dimensions of the plates of the lower stamp (angle of pressure distribution of 35-45^{o}), the specific pressure for calculation of deformation should be assumed to be equal to those distributed over the contact surfaces. Since the mean value of specific pressure has been reduced, the magnitude of deformation under the stamp corresponds to analogous deformations in metal frames or slightly exceeds them.

Crossbars in the form of semidiscs resting against the frame columns function as spacers. As in the crossbars of the cylindrical bases, their volumetric prestressing is also achieved by restricting the lateral deformations during the process of winding the tendon belts with the help of the end metal plates connected by reinforcing rods.

The columns of presses that operate on central pressure are made from concrete in a yoke of pipe and concrete.

In cylindrical frames, the average stress in the columns from reduction of the vertical working reinforcement is about 80 MPa and the stress differential under work loads is 10-15 MPa. For the support elements of the machine it is important that their deformation be minimal and that they work in an elastic stage. Studies conducted at the Science Research Institute of Ferroconcrete and Concrete have shown that pipe and concrete columns can work elastically work at loads of 1/4 to 1/5 of the failure level. At the same time, the load characterizing the elastic work of elements is sharply increased with the introduction of an additional longitudinal reinforcement mentioned above.

Pipe and concrete elements efficiently counteract the effects of repeated loads. After 100 cycles of a load at values of up to 0.7 failing load, the longitudinal and transverse deformations of elements are stabilized. The strength of models that had worked through 3.5 million cycles of repeated loading were not lowered in comparison to the same models tested only under static loads.

The vertical reinforcement in crossbars, columns and the power cylinder of a press with a cylindrical base is set into the channels formed by gas pipes. In cylindrical frames, steel (grade 23Kh2G2T and 20KhG2S) reinforcing rods of a diameter of 40 mm were used. During the process of tensioning rods with a redesigned standard tension jack for a DS-60 rod reinforcement a thrust nut is attached at a force of up to 650 KN for each rod.

With an opposite anchor end, the rods are turned into anchor plates with conical openings and are attached by the same type of nuts. Part of the roads are tensioned from the upper face of the press while the others are tensioned from the lower face. This makes them more compact and reduces by 2-3 times the distance between rods.

The tendons of bases with curvilinear semidiscs are cold-drawn wire belts placed along the outer course. These are wound onto the base with the help of turntables. The 5 mm wire is wound at a tension of 20 kN.

As we know, the elements of the lower stamp are a complicated structure that require massive forging from high-strength steel. This limits the possibilities of machine factories, especially in the manufacture of heavy-duty and super heavy-duty forge presses.

Some technical solutions worked out by the Science Research Institute of Ferroconcrete and Concrete have made it possible to make these elements out of high-strength prestressed pipe-concrete that gives the structure greater elasticity at specific pressures of up to 400-700 MPa with an element support strength of 100-1200 MPa. These elements can be of any size, limited only by transportation and assembly requirements and they can be manufactured by almost any plant without any special heavy-duty casting or pressing equipment.

The most complex elements of presses are the hydraulic cylinders. When they are manufactured from prestressed ferroconcrete, it becomes necessary not only make sure that the structure is strong and air-tight at working fluid pressures of 30-50 MPa but also that deformations are kept within ranges that the seals can withstand.

Cylinders cannot be made from ferroconcrete alone because they consist of three layers. The cylinder's inner metal jacket makes it air-tight, assures its exact size (by machining) and only partially absorbs the pressure of the hydraulic fluid. A ferroconcrete cylinder wall and pretensioned multi-layer winding of high-strength cold-drawn reinforcing 5 mm wire strengthens the structure by absorbing most of the outer pressure of the hydraulic fluid and the full force of prestressing. The bottom of the ferroconcrete cylinder is not firmly attached to the wall and this eliminates any local pressure concentrations in the thick-walled cylinder. These elements are joined by a longitudinal stressed reinforcing rod that in most cases is also the longitudinal working tendon of the press base. In comparison to an entirely metallic cylinder, this design reduces the steel content by 4-5 times and improves operating characteristics by reducing pressure differential and concentrations in the cylinder's steel jacket which in turn extends its service life. Studies conducted by the Science Research Institute of Ferroconcrete and Concrete have shown that for hollow ferroconcrete cylinders with wall thicknesses equal to their inner radius, the deformations are elastic in nature at tensions corresponding to the internal pressure exceeding by 1.2-1.4 times the cubic strength (the strength of the cube of the dimensions 15 x 15 x 15 cm withstood for 28 days under normal humidity and temperature) of concrete. Failure occurs at pressures equal to 2.35-2.65 cubic strength.

Therefore, ordinary concrete can be used to manufacture for presses powerful hydraulic cylinders for fluid pressures of up to 60 MPa.

Along with widely-used ferroconcrete structures, increasing use in construction is being made of composite ferroconcrete elements made in the form of concrete enclosed within a metal jacket that can be prestressed if needed.

Research has shown that ferroconcrete elements with an external metal jacket are 4-8 times more resistant to central pressure than ordinary concrete elements. In this case the local stresses 2.5-5 times exceed the cubic strength of concrete and the elasticity of the entire element is preserved. To an even greater degree, the strength of concrete in a casing such as a pipe and concrete element can be increased by additionally reinforcing the concrete core with high-strength reinforcing rods that are 5 times or more stronger than metal casing pipes. This raises the strength to 1700 MPa.

The structural resistance to pressure of such elements can be increased beyond that of analogous metal parts in the form of massive forgings and castings. For example, composite pipe and concrete high-strength elements (figure 5) have been developed at the Science Research Institute of Concrete and Ferroconcrete significantly increase structural elasticity.

The limit to elastic work of a metal and ferroconcrete composite element 5 times exceeds that of metal pie and three times that of a concrete core. In these elements, the total steel consumption was less than 30 percent of the area of the cross section. This models withstood an average stress of 350 MPa along their cross sections. With an increase in the amount of high-strength reinforcement within the pipe, the support strength of these elements is sharply increased. Experiments have shown that composite structures can work elastically at stresses of over 700 MPa (over the entire cross section). As we know, due to liquation in massive steel castings, it is practically impossible to achieve such a high degree of strength.

Ferroconcrete composite structures with an outer surface insulated by metal are more resistant to corrosion by oil and emulsions than ordinary ferroconcrete structures an they are also more heat resistant. This makes it possible to weld less crucial components and parts to the structure.

Aside from this, the removal of the basic metal to the outer surface of the ferroconcrete structure makes it possible to reuse this metal for other purposes once the amortization period has expired. At many plants producing ferroconcrete parts, machines mechanically tear down rejected ferroconcrete structures by extracting the metal and manufacturing metal ballast.

The technology and equipment used for this produce scrap more cheaply than briquetting and packaging in hydraulic presses.

The simplifying properties of ferroconcrete can be enhanced by prestressing the structure during its manufacture. This induces pressures in it that exceed the tensioning stresses during operation.

As a result of this, there occur only single-value pressing forces in the basic support elements of the structure that absorb tensioning forces.

The reinforcing steel used in ferroconcrete elements can also be reused.

At the present time, it is now proven that it is technically and economically feasible to use prestressed ferroconcrete to manufacture base elements and power organs of hydraulic presses with closed bases that are manufactured by the machine industry.

For the broad introduction of forge presses with ferroconcrete bases and power elements, it is necessary to concentrate work under a specialized industrial organization that would provide:

-- a specialized design bureau on ferroconcrete press construction including specialists on the development of technical documentation;

-- a branch laboratory to conduct research on the development and analysis of the behavior of the ferroconcrete structures in presses under industrial conditions;

-- experimental production combining a plant producing ferroconcrete structures of strength of up to $25m^3$ per year with machine production that would make it possible to produce more than 3000 forge presses per year that are analogous to 20 MN industrially produced presses and would save more than 30,000 tons of metal per year.

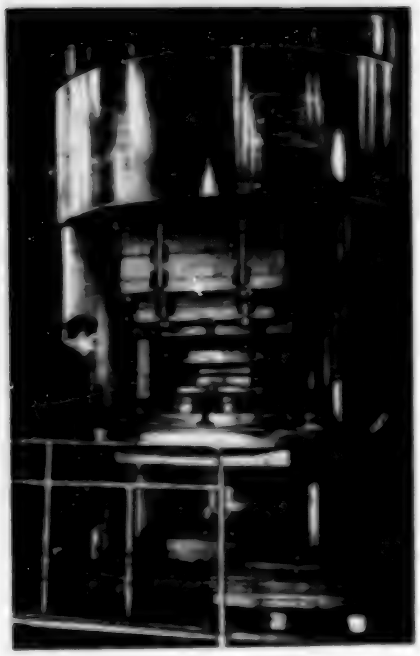

Figure 1

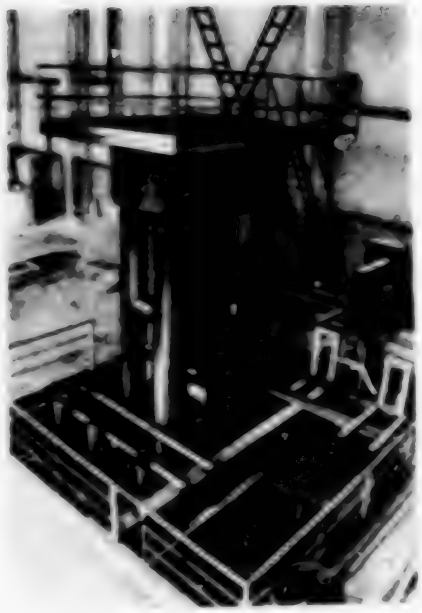

Figure 2

Figure 3

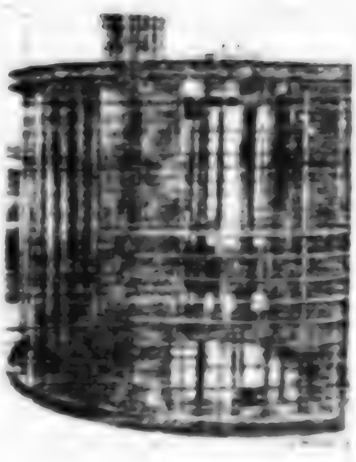

Figure 4

Figure 5

1	2	3	4	5	6	7
8 Гидравлический пресс [illegible]	Станина 19	[illegible] 22	[illegible]	[illegible]	[illegible]	[illegible]
9 Гидравлический пресс усилием 40 МН для [illegible]	Станина и с[illegible] 20	[illegible] 23	[illegible]	[illegible]	[illegible]	[illegible]
10 Гидравлическая [illegible] усилием 20 МН для тарирования [illegible] работа прокатных станов	Станина 19	[illegible] 22	[illegible]	[illegible]	[illegible]	[illegible]
11 Гидравлическая [illegible] установка усилием 25 МН для тарирования [illegible] работа прокатных станов	"	"	[illegible]	[illegible]	[illegible]	[illegible]
12 Установка для гидравлического прессования усилием 30 МН	"	"	[illegible]	[illegible]	[illegible]	[illegible]
13 Установка для гидростатического прессования усилием 40 МН	"	"	[illegible]	[illegible]	[illegible]	[illegible]
14 Установка-газостат усилием 50 МН	"	"	[illegible]	[illegible]	[illegible]	[illegible]
15 Гидравлический пресс для прессования порошков усилием 40 МН	Станина и с[illegible] 20	Челябинский [illegible] завод 24	[illegible]	[illegible]	[illegible]	[illegible]
16 Гидравлический пресс для прессования пластмасс усилием 45 МН	То же 20	[illegible] 25	[illegible]	[illegible]	[illegible]	[illegible]
17 Гидравлический пресс для испытания строительных конструкций усилием 40 МН	Станина, силовой цилиндр, [illegible] 21	НИИЖБ 26	[illegible]	[illegible]	[illegible]	[illegible]
18 Гидравлический пресс усилием 50 МН	Станина 19	[illegible] «Красный гигант» 27	[illegible]	[illegible]	[illegible]	[illegible]

List of some industrial forge presses with ferroconcrete elements made using designs from the Science Research Institute of Concrete and Ferroconcrete*

Key: 1. Machine and its basic parameters; 2. Parts replaced by ferroconcrete; 3. Manufacturer; 4. Overall weight of metal part; 5. Weight of ferroconcrete part / weight of metal components; 6. amount of metal saved, tons; 7. Savings in rubles; 8. 30 MN double-action hydraulic press; 9. 40 MN hydraulic press for precision stamping; 10. 20 MN hydraulic press installation for calibrating the screw-down mechanisms of rolling mills; 11. 25 MN hydraulic press installation for calibrating the screw-down mechanisms of rolling mills; 12. 30 MN hydraulic press; 13. 40 MN hydrostatic press; 14. 50 MN hydrostatic pr ss; 15. 40 MN hydraulic press for pressing powdered materials; 16. 45 MN hydraulic press for pressing plastic materials; 17. 40 MN hydraulic press for testing structures; 18. 50 MN hydraulic press; 19. base; 20. base and power cylinder; 21. base, power cylinder, spacers; 22. All-Union Science Research Institute of Metal Machinery; 23. Bolshevo Machinery Plant; 24. Chelyabinsk Grinder Factory; 25. Cheboksary Energozapchast Plant; 26. Science Research Institute of Concrete and Ferroconcrete; 27. The Nikolsk Red Giant Factory.

* A total of 36 presses of different designs and pressures have been designed and manufactured since 1959.

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OTHER METALWORKING EQUIPMENT

BRIEFS

NEW PRESS--Recently the collective of the Voronezh Association for the Production of Heavy-Duty Presses gave representatives of Moscow Automobile Factory imeni I.A. Likhachev a unique 12,500-ton press. This machine will work within an automated line for hot stamping large forgings of up to 160 kg. The new press will increase labor productivity in these operations by 50 percent, replace 19 workers and save about 3500 tons of metal annually from the stamping of crankshafts. The structural and technological properties of this press are covered by 14 patents. This is one of many of the projects that have shown the gifted engineering abilities of the association's chief designer, Ivan Nikanorovich Filkin. He has been directly involved in research aimed at raising press production by 1.6-2 times. Under his supervision, the association's engineers and inventors were the first in the world to build double-action hot-stamp presses. In the design bureau, laboratories and shops of the association, the creators of this new technology have carried out a great amount of scientific research, experiments and design work to equip heavy machinery with mechanizing and automating devices, industrial robots and manipulators and devices to protect equipment against overloading. As part of the creative group of workers of the Voronzezh Association, I.N. Filkin received the 1984 USSR State Prize for science and technology. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 1, Jan 85 p 15] 12261

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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

FROLOV VIEWS PROS, CONS OF FMS IN INDUSTRIAL BASE

Moscow SOVETSKAYA ROSSIYA in Russian 17 May 85 p 3

[Article by Aleksandr Nemov, science columnist of SOVETSKAYA ROSSIYA: "New Technologies: Automation at work: What does the creation of FMS give us?"]

[Text] It is already obvious by now that the growth of our economy requires the creation of flexible manufacturing systems [FMS]. What has made their introduction so necessary to to industry? What problems have the creators of FMS encountered in their work and what are the practices used in the operation of such systems? What place will man take in future automated production systems? These and other problems were discussed below by: K.V. Frolov, vice-president of the Academy of Sciences of the USSR, representative of the Academy Council on the Theory of Machines and Machine Systems and director of the Institute of Mechanical Engineering of the Academy of Sciences; A.N. Makarov, USSR Deputy Minister of Higher and Middle Special Education, chairman of the Academy of Sciences Council on Robotics and Automated Production and correspondent member of the Academcy of Sciences; and P.N. Belyanin, director of the Institute of Technology and Production Organization and correspondent member of the USSR Academcy of Sciences.

Resetting on Command

Belyanin: To begin with, I would like to point out the fact that today, production machinery is operated only 600-700 hours out of the 8760 hours of their annual time fund. Much time is lost waiting to receive blanks or parts to be worked or repairing malfunctions. More than 6000 hours fall during the evening or night periods and holidays. As you see, a rather small part of this total time is spent in actual production. Therefore, there exists a colossal amount of possible output that goes unused. This extends the pay-off period for the machinery which more quickly becomes obsolete.

It has become necessary to create continuous around-the-clock production systems using NC-machinery, robots, automated transport systems and automated control systems all combined within automated plants.

Frolov: It must be emphasized that either present or future automated production is not created from out of thin air. Over the past 10-15 years, we have made considerable progress in this area and just as many errors. Therefore, many of them are the result of an ill-considered desire to reach the new boundaries of scientific and technical advancement in one jump. For example, let us take the introduction of automated control systems to factories. The right line of policy has been taken but this approach requires that industry must also be realized to a new level because automated control systems are most effective where all of the production processes are automated. If most of the production in a factory is done manually, then the money spent on automated control is wasted.

Here is another example. As early as the 1950's, an automated plant was built in Ulyanovsk. Only 5 operators were needed to work this plant but after only a short time, it became necessary to close and disassemble this plant. This was not done at the whimsy of economic management experts but was absolutely necessary as the plant was producing only one type of part which soon ceased to be needed and production had to be stopped.

Therefore, it is no coincidence that flexibility or quick readjustment for new production is mentioned when speaking of a modern automated factory.

Another example is the production of the Moskvich automobile. Demanding buyers prefer it to the Zhiguli. However, the Moscow Moskvich Automobile Combine is undergoing extensive readjustment. New automated welders are being built. They are used to back weld the body of any automobile instead of just one type.

There are now 6 robots being used at this plant and by the start of the next five-year period, there will be 500. This is a serious step forward to the production of a new Moskvich model every two years rather than every 7 years as before. This is also a step forward to FMS even if, as you will admit, it has been somewhat late in coming.

Makarov: The problem of introducing robots has still one more aspect. Let us say that the new robot-welder at AZLK [not further identified] can weld 24-30 points per minute on a car body while a man can weld more than 50. What is the advantage of using a robot? A robot can weld very accurately and evenly for 24 hours a day while a man sometimes makes mistakes and can work only one shift at a time. Industry today needs 100-percent quality. Only robotics and automated systems can fulfill this need.

Belyanin: I would like to point out that many industrial leaders have recognized the advantages of using NC-machines and robots. However, it has been difficult to create FMS systems with just a few NC-machines, transport systems, robot-manipulators and an automated control system. Plant directors have adopted a certain attitude to this: "We know that we must introduce complex systems but we cannot do so without having to deal with many new problems".

I have come up against the same attitude. Our institute has developed and FMS and even though this project turned out to be a "complicated" one for plant workers and the responsible officials in the ministry, they did succeed in introducing it.

This was not done at once or without problems but the system did work. Production was started using the FMS and "just in case", the plant did leave some nonautomated shops running to turn out the same parts as our FMS. Did it break down all at once? They were finally convinced that FMS is something that really works. For 5 years now, our system has been turning out very complicated automobile body parts at a fixed pace.

Now, we must produce FMS and their creation should be included by law in the state plan.

I would like to talk about the problem of providing needed tools. Automatic tool changing (such as changing a drill or cutter) places high demands on the tool itself. And, as before, it is transformed from a relatively simple device into a more complex, high-precision unit made of many parts. However, industry is still not ready to mass-produce such tools.

At our plant, it became necessary for us to begin production of everything for one FMS line. Nevertheless, the plant came out ahead with this as it increased work discipline.

I hope that the Ministry of Machine-Building Industries which is responsible for creating flexible industrial machine modules and systems will consider the need for expanding the production of tools for this new technology.

Tasks for Computers

Frolov: One of the problems which is still not properly appreciated is that of the software used by computer complexes without which flexible production is impossible.

Unfortunately, we still have only a small percent of the programs we need for computers to be able to not only control machines, presses, welding apparatus and conveyors but also aid in the designing of new devices and machines and perform other remaining engineering tasks in industry. A computer without software is nothing more than a bunch of electronic circuits.

Makarov: The creation of FMS requires a sufficient number of all different types of computers with the necessary peripheral devices and, as Konstantin Vasilyevich [Frolov] has already said, the necessary software without which this technology cannot be effective. There has arisen a growing need to create organizations that can customize software for industrial-grade control systems using modern computers. The Ministry of Instruments, Automation and Control Systems [Minpribor] has had some experience that must be used.

Much work is being done within the USSR Academy of Sciences and abroad to develop software but still more work must be done to turn out a finished product.

Frolov: Still one peculiarity of FMS. For it to even come into being, the latest technology must be introduced. This includes plasma spraying which increases by several times the abrasion resistance of parts and laser-based superfine measurements, powder metallurgy and vibration technology. There is now a new trend in robotics that has been brought to life by FMS -- resonance robotics.

When production systems used one robot, the energy costs were negligible but modern FMS uses as much as hundreds of robots and the problem of energy for these robots is becoming much more serious. Scientists have found a solution in the resonance robot which requires only one-fourth of the power of a conventional robot and can work 10 times as fast. However, industry introduces such innovations much slower than science finds them.

Makarov: In speaking of FMS, we have dealt with only side side of it -- the machinery. But man cannot escape the industry of the future. Only the functions change. Workers will be forced to raise their level of skills to that of a technician or even to those of an engineer. They will not only have to operate systems but rebuild them if necessary and adjust them for new production. Such a specialist will have to work much more with computers.

I referred to the production of the future but FMS has already been created, is undergoing development and is being used. This means that we should have already now solved the problem of substantially improving the qualifications of everyone actively involved in the production process (as well as those still to come). If we did not think of that before, this means that we must make up for it now. One of the main components in the training of new specialists should be active study and practice with computers during the training process and this should be begun in grade school.

Special computers are now being provided for schools but it will be a long time before they take a "place of honor". What is the solution? I think that it might be obligatory and universal education of teachers (physics and mathematics teachers, above all) to work with computers.

Acceleration of the use of computers in popular education cannot be achieved without the help of industry. One important step may be providing schools with computer facilities.

Man and Robots

Belyanin: Retraining of engineers, workers and technicians for the new technology can be turned over to computers themselves. A computer is not only capable of putting needed information on a display screen but it also uses "video games" to teach personnel the habits needed for their work.

Such games require quick reactions and instantaneous speed. In order to benefit from the use of a computer, long-term training is required. Video games are not only entertaining but can be used to model production processes and such computer training can teach a person much more than 10 boring lectures.

Minicomputers should become a natural part not only of schools but also of family life. It is obvious that we must therefore lower their cost and as well as the cost of electronic equipment.

Makarov: In order to bring about the widespread introduction of computer technology, specialists on computers, microelectronics, applied mathematics and automated control systems must be called upon. How are they be trained? Year after year, their numbers increase. New specializations are being discovered and existing ones are being elaborated to better meet the needs of industry. One of these recently emerging specializations is connected with the training of robot and robotic systems specialists but this is not enough for today. Along with schools with a well-developed computer base, there are just as many in which a computer is a rarity.

The sad thing is that there are still many schools where only a small number of teachers can operate computers. Even in schools of higher education that have been "blessed" in this regard, more than half of the faculty lacks needed computer skills. This problem is improving somewhat now but it cannot be entirely solved as long as schools lack the necessary number of modern computers of all classes.

I hope that The USSR State Plan, State Committee on Material and Technical Provision, the State Committee on Science and Technology and other organizations will become our allies in "electronic" reequipment of the Ministry of Higher and Secondary Specialized Education. Higher education will do the rest for itself.

Frolov: Aside from cadre training, there are still other problems involving man and automated industry.

One continually meets people who think that automation can free man from labor but this is something which has still not come to pass. Automation only changes the nature of man's work, frees us from exhausting jobs and for the most part demands that we change our attitude to work.

Automated production in which continuous work and a fixed rhythm are more important than in any other form of industry demands that workers be responsible, precise and well-disciplined. Experience in operating automated production lines and robots has been very good. In plants that have successfully been adapted to the new demands and work discipline and knowledge has been improved, automation is being effectively used while in those that have waited for the robots themselves to increase work productivity have been disappointed.

Work has already begun on the factory of the future and responsibility for its success should be felt not only by designers and scientists but also by factory managers, ministries and institutions.

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ADVANCED MACHINE TOOLS IN UKRAINIAN INDUSTRY NOTED

Kiev PRAVDA UKRAINY in Russian 18 May 85 p 3

[Article: "To Raise the Level of Large-scale Mechanization and Automation of Production"]

[Text] A recent meeting took place between Ukrainian CPSU Central Committee's Council for Cooperation in Scientific and Technical Progress with the leaders of various republic ministries, institutions, party and social organizations and councils, scientists and economic experts.

The discussion during this meeting centered on how to use the experiences of progressive plants in large-scale mechanization and automation of production, the implementation of robotic technology and enhancing the role of party committees in solving these problems.

The council feels that the Ukrainian Republic has been acquired a certain amount of experience in working with large-scale mechanization and automation of industry and the use of robotics. Since the beginning of the current five-year period, 9700 mechanized continuous-production and automated lines have gone into operation, 11,300 shops, sections and plant operations have been comprehensively mechanized and automated and more than 4000 individual robots have been introduced. The average annual rate at which manual labor in industry is being reduced has grown and mechanization and automation technology has replaced more than 220,000 workers.

However, the pace and scale of this work is still not keeping up with demands and the possibilities offered by the Ukraine's scientific, technical and industrial potential. The introduction of robotics and other means of mechanization and automation has been uncoordinated and has not improved the technical sophistication in industry or raised worker productivity as much as it should nor has it substantially reduced manual labor.

The level of mechanization and automation in auxiliary and maintenance operations has remained fairly low. Much manual labor is still involved in the operation of mechanized and automated lines and sections. Plants frequently lack precise and realistic programs for solving these problems, engineering and technical measures and plans for new technology are still

uncoordinated and are directed at solving local tasks. The demand for progressive technology is often not met by the organization of production. These shortcomings are especially characteristic of coal mines, dairies and meat-packing plants, the food-processing industry, ferrous metallurgy, the republic's construction materials industry and the industry of the Crimean, Khmelnitsky, Kherson and Chernigov oblasts.

The design, construction and technical organizations of different branches of industry are not working at the level that they should. Some designs are produced without any consideration of how they can use large-scale mechanization and automation of technological processes. Not enough work is being done to create FMS or processes that use rotary and rotary-conveyor lines. New plants are often built with a large amount of manual labor.

The cooperative councils for scientific and technical progress in oblast, city and regional committees are not paying enough attention to comprehensively solving the problem of how to gradually eliminate manual labor or efficiently use modern automation nor are they trying to make the results of successful work in this direction by progressive plants of the Ukraine, fraternal republics and the cities of Moscow and Leningrad into the achievement of every worker collective.

On the basis of the tasks set by the April (1985) Plenum of the CPSU Central Committee tasks for substantially increasing the effectiveness of Soviet industry by hastening scientific and technical progress, the council recommended comprehensive measures to be taken to increase the pace of mechanization and automation of industry.

The Labor Scientific and Technical Program for the Ukraine for 1986-1990 calls for a 200-300 percent increase in the reduction of manual labor, the development and implementation of measures to hasten the technical reequipment of existing plants through the introduction of advanced technologies, robotic complexes and FMS, completion of work on certification, attestation and making better use of work places, the establishment within plants of subdivisions for designing, manufacturing and using mechanization and automation devices and the determination by research, technological-construction and design institutions of the structural subdivisions that are responsible for the development of designs and the introduction of robotic processes.

It was suggested that there be more preparation and training of engineers, technicians and workers in the creation, adjustment and operation of modern automated processes and equipment.

The collegia of ministries and institutions were shown the need for plants to increase highly-effective activity to introduce and use mechanized and automated processes and robotics and to provide for this purpose the necessary material, technical and financial resources.

The Ukrainian Council of Ministers Presidium commission on scientific and technical progress has recommended a review of the status and prospects of increased scientific research and experimental design work aimed at sharply increasing the level of mechanization and automation of labor in the different

branches of the Ukraine's economy and to accelerate the practical implementation of the results of this work.

It has been recommended that the councils for cooperation in scientific and technical progress in the oblast party committees and the Kiev City Party Committee cooperate with the scientific centers of the Ukrainian Academy of Sciences, industrial design and technological organizations and institutions of higher learning to formulate regional programs for the 12th five-year period that call for measures for immediate comprehensive mechanization and automation of labor in different branches of the economy. These programs must also establish active control over the creation by Ukrainian factories model and instructional FMS systems.

Politburo member and Second Secretary of the Ukrainian CPSU Central Committee A.A. Titarenko informed the conference about the the implementation of the Ukrainian CPSU Central Committee Council of Cooperation in Scientific and Technical progress's recommendations for additional measures to lower material consumption in major construction projects and the formation of scientific and technical programs for the 12th five-year period.

CPSU Central Committee Politburo member and First Secretary of the Ukrainian CPSU Central Committee V.V. Shcherbitsky also spoke at the conference.

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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 621.9.06-529:658.527:629.113.002

AUTOMATED MACHINING SYSTEMS IN MOTOR VEHICLE MANUFACTURING

Moscow AVTOMOBILNAYA PROMYSHLENNOST in Russian No 2, Feb 85 pp 26-28

[Article by V. F. Rzhevskiy, NIITavtoprom (Scientific Research Institute of Automotive Industry Technology)]

[Text] New technological processes and equipment developed on a base of the latest achievements of science and engineering are successfully eclipsing old production methods or are radically transforming them at branch enterprises. It is precisely these changes which are largely ensuring the progressive technical-economic characteristics of automotive equipment, its high quality, good working conditions and maximum useable effect with minimal expenditures.

The flexibly readjustable automated, highly productive metalworking equipment such as machining centers and block-centers are of special interest in this regard, and quite understandably so, as the unitized machine tools, automatic lines and line complexes now in use at branch plants have generally been designed for and are intended for the highly productive machining of specific pre-assigned parts and so do not possess the necessary flexibility to allow the rapid replacement of production targets. Even the so-called adjustable automatic lines (such as ones for machining a forward cylinder block head (two types), eight modifications of intake manifold lines adjustable from a central control panel, three types of cylindrical drive gears and several other parts used at the KamAZ) designed for pre-assigned specific parts and not intended for machining analogous parts used in other vehicles. (This is one reason why production workers are unwilling to change and modernize the products they produce.) Machine tools with programmed control -- machining [processing] centers -- do not have this primary shortcoming of traditional equipment: they can be quickly adjusted from one part to another. Moreover, they possess great rigidity, reliability of operation, programming convenience, and they are equipped with tool bins and rapid power and transport subassemblies which ensure a threefold or higher increase in productivity.

It is therefore precisely these machines which are now resolving the task of highly productive machining of a broad products list of automotive body parts. The creation of flexible production systems (GPS) based on NC machine tools and machining centers is a prerequisite to further raising the level of technology and automotive manufacturing production organization. The fact is that modern NC machine tools, and machining centers in particular, significantly

surpass the indicators of machine tools of preceding generations in terms of precision and speed of operation. They are generally equipped with electronic control and monitoring systems, automatic tool adjustment, precision cutting fluid cleaning devices and other special technological attachments and accessories permitting an improvement in machining productiveness.

The GPS is something comparatively new. For example, foreign machine tool manufacturing companies specialized to produce automatic lines began developing and manufacturing them only in the late 1970's. The basic equipment comprising a GPS for manufacturing body parts is multipurpose NC machine tools and heavy-duty machining centers with replaceable multiple-spindle (4-24) heads and asynchronous transport links based on robot-carts (with photo-sensors or an induction system) or computer-controlled satellite pallets. True, the GPS has thus far not achieved full use of its potential: they can machine only parts which do not differ greatly in weight, dimensions and technological operations. But other machining schemes are also used for large body parts. For example, the item being machined remains in a single position while a multiple-spindle box (tool head) moves down the length of it. Readjustment from one item to another reduces basically to replacing the tool blocks.

The various design modifications and technological machining schemes used in GPS's require study and analysis. In order to avoid oversights and failures when introducing GPS into automotive production, we need a clear idea of the potential advantages inherent in their concept, as well as of how these advantages can be actualized to maximum effect. Let us examine these questions.

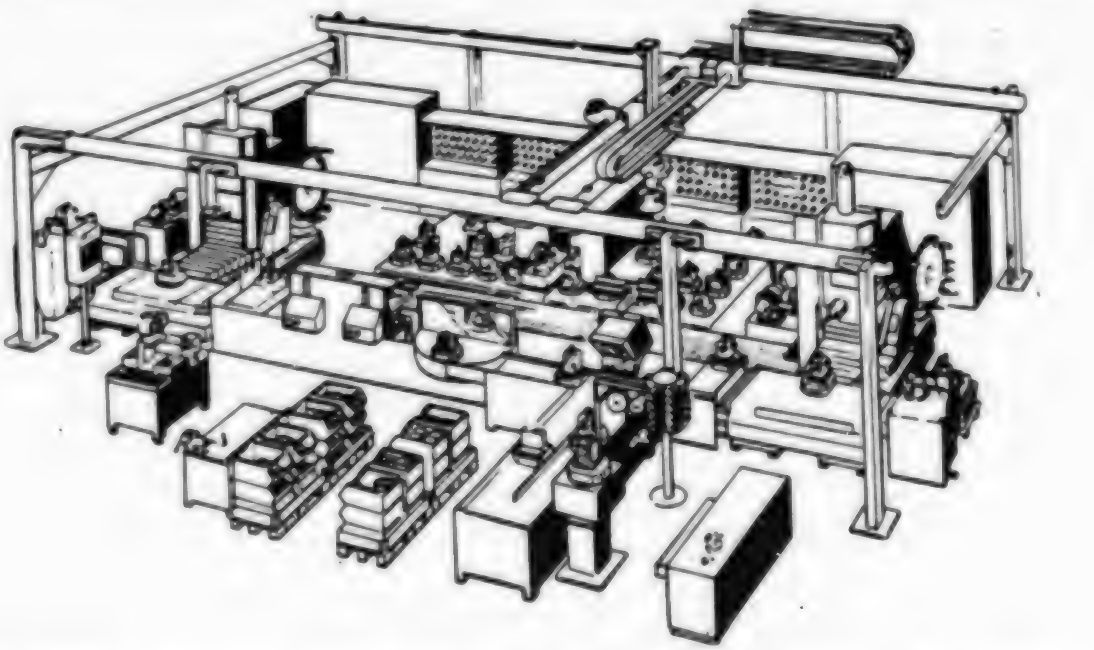


Figure 1 shows a GPS cell consisting of two machining centers. The computer controls the blank and tool feeds and the satellite pallets and portal robot (manipulator). The GPS control systems being used are basically a tri-level type. The first level is operating equipment control using programmable controllers and NC devices whose functional potential is determined by the characteristics of the

equipment. The second is operative production and transport-loading operation management using mini-computers interfaced with the first level. The third is the processing of administrative and production data and controlling technological routes in real time.

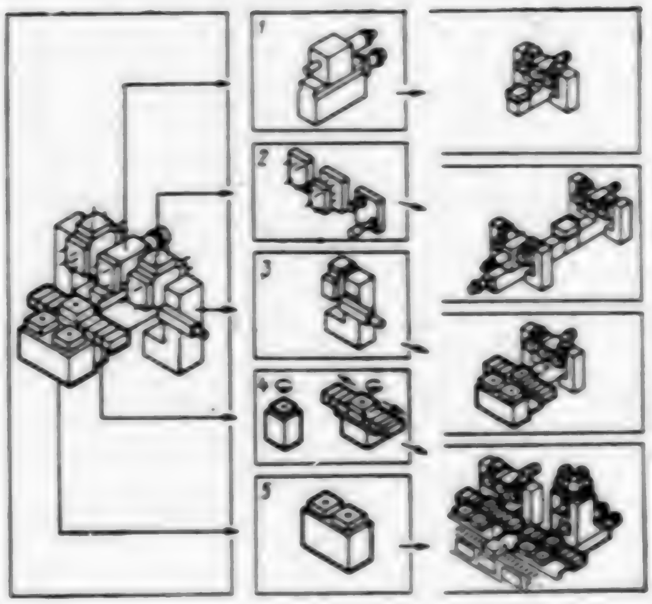
Constant improvement in the programmed control systems and drives of metal-cutting equipment and expanding the use of computers and programmable command-apparatus have permitted a significant rise in the productivity and precision of machining. The multipurpose integrated circuits used to control equipment and technological processes reduce dozens-fold the size of the control devices; they simplify installation connections, sharply improve the reliability of operation of NC systems and facilitate the development of equipment diagnostics systems.

A consolidated analysis of GPS operating data for machining body parts in machinebuilding branches shows that multiple-product flexible manufacturing systems [flexible automated production facilities] have justified themselves when programmed to produce up to 20,000 items per year; given more considerable production levels, it is economically appropriate to use automatic lines in a classic layout, with rigid operating cycles.

Joint work by automotive manufacturing technologists (machine tool consumers) and specialists at Minstankoprom [Ministry of Machine Tool and Tool Building Industry] design bureaus (designers) has revealed the basic principles for setting up flexible automated machine-tool systems for series production with frequently changing machining targets. In the course of this work, they determined the necessity of creating a new type of metalcutting equipment capable, as part of a flexible machine-tool system, of multispindle machining not only of the bulk of the fastener and other medium- and small-diameter openings, but also of precision openings which determine the quality of the item. The block-center will be such equipment. (Its composition and machine-tool cell variants are shown in Figure 2, and their main technical data are given in the Table [both on following page].)

The "tool-to-item" principle economically confirmed by the whole range of machining centers being produced at the Ivanovskiy Machine-Tool Production Association imeni 50th Anniversary of the USSR (ISPO) enables us to combine in the block-center the flexibility of a multiple-operation NC machine tool with the productivity of the automatic line: the former is achieved by the possibility of quickly replacing multiple-spindle head units, and the latter is achieved by multi-spindle machining. The NC block-center created on a base of unitized machine-tool subassemblies will have design and technological parameters which must enable it to be included, without additional systems or devices, in flexible automated machine-tool sectors built with existing machining centers. And the high level of automation and reliability, based on unitizing finished, proven subassemblies and design resolutions, as well as on the inclusion of the most modern systems of adaptive control, monitoring and diagnostics, must provide, using flexible automated machine-tool systems built from these block-centers, all the qualities necessary for highly productive, reliable operation using "unmanned" technology.

Figure 2.

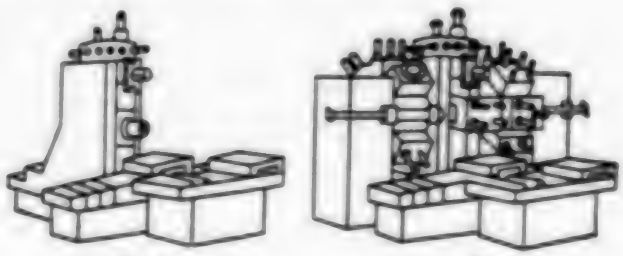


position in Figure 2	technical specifications	
1	power, kW	15-30
	rate of rotation, min^{-1}	50-1500
	greatest travel, mm	800
	feed force, H	100,000
	working feed, mm/min	1-2000
	fast-forward, m/min	10
2	(drill bits)	
	greatest number of spindles	50
	largest drill bit diameter, mm	40
	reduction (change in rate of rotation), times	0.5 - 2
	(threader)	
	greatest number of spindles	30
	(milling-boring head)	
	greatest machining diameter, mm	180
	greatest milling diameter, mm	125
	greatest number of spindles	9
3	number of positions	4
	head replacement time, seconds	10
	cycle, seconds	20
4	(coordinate B)	
	load capacity, H	15,000
	indexed rotation	5°x72

[continued on following page]

(4)	(coordinate X)	
	greatest travel, mm	1000
	feed force, H	8000
	working feed, mm/min	1 - 2000
	fast-forward, m/min	10
5	number of positions	2
	pallet replacement time, seconds	45

Further. Since the block-center is the same automated cell as the machining center used in the automated sector system of the complex, the natural continuation of its development must be complexes based on block-centers, as well as block-centers and machining centers built on a single unitized base including adjacent facilities such as storage, transport, robots, manipulators, and so on. For example, combining a block-center with "machining-center" types of machine tools created on a single unitized base into a unified technological line could resolve all the questions of highly-productive, flexible machining of a specific list of automotive body parts.



(a) (b)

This is unquestionably a progressive direction in resolving technological and organizational tasks. This has been confirmed by domestic and foreign experience. For example, the ISPO's IR 800 MFU4 (Figure 3a) and block-center (3b), based on series-produced machining centers, must inherit their best design-technological features: precision tempered guides and their telescopic protection; rigid, highly precise ball-bearing screw gages; a.c. (motor) spindle drive with a wide range of adjustment; highly productive cutting fluid feed system to cool tools and parts being machined; effective shavings removal from the enclosed cutting zone.

Increasing the reliability of modern flexible automated machine-tool systems must be ensured through their effective servicing by skilled personnel, which is quite possible and attainable through the extensive unitization of the design resolutions both of the equipment itself and of the control and monitoring systems.

In conclusion, it should be noted that the branch has already accumulated some experience in operating NC machine tools. For example, the BelAZ uses NC machine tools and machining centers to machine large body parts for large quarry dump trucks. The system consists of 101 NC machine tools, including 77 machining

centers controlled by computer (transport-unloading and warehousing operations have not yet been automated here). The branch is using machining centers and NC machine tools to create (with varying degrees of automation) broad-products sectors for machining parts in both basic and tool-die production at the GAZ, ZIL, KamAZ, GPZ-15, GPZ-11 and a number of other plants, that is, the prerequisites necessary to further automate production through the extensive use of industrial robots and microprocessor equipment are being created. For the first time, the branch is setting itself the task of comprehensively solving the problem of using flexible automated equipment at the AZLK [not further identified]: in its current expansion and renovation stage, we are creating and introducing large numbers of complexes of adjustable automatic machining lines, with automatic multiple-spindle head replacement and the ability to change the automatic machining cycle through the use of micro-computers and programmable controllers.

The GPS must integrally combine the advantages of flexible technology and comprehensive automation and, on that basis, not only prepare production to resolve new tasks, but also rid it of "bottlenecks." But the primary importance of the GPS is that it increases labor productivity and fundamentally changes the character of labor: the decisive figures at the enterprise will be operators of complexes, specialists in electronics, precision mechanics and drives, and highly skilled trouble-shooters. Many of them will require not only a secondary education, but a higher technical education as well.

11052
CSO: 1823/183

AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

EXPERIENCE WITH PHASED IMPLEMENTATION OF FMS REVIEWED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 17 Apr 85 p 4

[Article by I. Klimenko and L. Tsvetkov: "Towards Flexible Systems: The Experience of the Andropov Motor-Building Association"]

[Text] The staff of the Andropov Motor-Building Association has for many years consistently and purposefully been reconstructing its technological equipment and perfecting the organization and control of its production processes.

In the present stage of this work, the association is converting its operations from semiautomatic production to automated production based on FMS.

The program for comprehensive automation marks a new phase in the operation of the association. The time has come to make a decisive break from old systems and take up a new superior material and technical level of production to solve the tasks set by the March plenum of the CPSU Central Committee: to bring about a decisive turning point in the national economy's switch to intensive development.

Economic Feasibility

The Andropov Association builds aircraft engines above all. This in itself suggests that constant renovation of production to stay on the crest of the wave is not just an episode in the life of the association's workers but a lifestyle. There is economic proof of this. All of the production subject to attestation is released with a mark of quality. This award is not a permanent one but barely lingers to distinguish the production.

There can be no halts or slowdowns, however temporary, of the pace of development. If the workers ever failed to meet even part of the production plan during the first quarter, it was because the demands of the leaders were too high.

There is one solution and that is to correctly determine priorities in the improvement of the production base and to gradually introduce automation.

The past experiences of the motor manufacturers has very clearly shown the advantages to using such tactics. For example, the present program for automation was preceded by a comprehensive plan for bringing in new equipment during the 10th and 11th five-year periods. Nine years have passed since the start of its realization. The production output has been increased twice during this period and this success has been the result of properly choosing the chief directions to be taken. Capital investment was used above all to renew the active portion of production funds while gradual replacement with newer equipment proceeded continuously. As a result, practically all of the indicators of efficiency saw substantial improvement. Fund reimbursement was increased by 6 percent. Production output per square meter of work surface went up slightly less than 75 percent while worker productivity increased 100 percent.

During the same period, the quality of the production base itself improved very much. In the main workshops today, almost every second worker operates a semiautomatic machine, an automated one automated lines or an NC machine. Therefore, there has been prepared a good starting point for the new stage of development -- conversion to flexible automated production.

What are the economic goals for this stage? Some of the most important are higher output, better worker productivity and the production of consumer goods. The program for this plant calls for substantial overfulfillment of the initial figures projected for the 12th five-year period. What technological means will be used to achieve this? The most attention here is being given to FMS sections not only in main production processes but also in the auxiliary ones, automation of design work and many other aspects. A sequence for equipment replacement has been prepared. For example, the continuing broad introduction of NC machines is supposed to crowd out old equipment. Great emphasis is being placed on acquiring the modular-design machines that can be used as primary elements of FMS. Other machinery will be used to form entire divisions that can be operated and controlled as a group. Gradually, automated control will be raised to an even higher level in which commands can be sent to automated transportation and storage systems, individual robots, robotic complexes and production lines.

The first flexible production division with operator-free technology will go into operation next year. It will be able to produce 37 large body parts for aircraft engines. Some specialists from a foreign firm said that, in its level of automation, the "FMS-1" will be the best automated complex in Europe.

However, FMS is a new and expensive technology. Under today's conditions, it would be a mistake to orient ourselves totally toward this system. Along with FMS, the program also calls for the introduction of fixed and strongly specialized automation equipment including automated production lines that can be used to produce tractor engines, for example. These engines have been very highly rated and local designers compare their service life with that of the tractor as a whole. The demand is good and sales are guaranteed and the proposed improvements do not affect the parts that will be produced by the automated equipment.

During preparation of the program, its economic effectiveness was very critically analyzed and it was thus found that the costs can be recovered in little over three years. If one considers reducing the number of workers and the cost of paying them, then the cost-recovery period is reduced to two and one-half years. It is obvious that the planned means for much more profitably expanding production will return the last invested ruble to the treasury in only 7 years.

In Defense of an Idea

At the association, they told us that "putting together a program is only one-third of the work. It still has to be put into action and for this, it is necessary to have the right materials, organization and training".

The most important step is for the program to be smoothly assimilated in the higher levels of administration. During discussion in the ministry directorate and bureaus, the association's inquiries are compared with plans and the capabilities of the branch. It is there in the ministry offices that creative thinking and grassroots initiative must pass their strictest survival tests.

In our case, the initiative of the association's workers received timely support from the ministry collegium. Therefore, the branch directors legitimized it and took upon themselves concrete duties and responsibilities. However, this same experience has shown that the support of the ministry does not alway mean that everything will continue running so smoothly. Past programs were not so smoothly embodied for the motor manufacturers. It was necessary then to take up matters with the branch administrative staff in order to have the necessary decisions made.

The present program will probably not be realized without a few hitches. Such is life. Anything new must make its own way into the world but at the Andropov Association, everyone is confident that what is planned will be carried out.

External support is also provided by approval given the initiative of the motor manufacturers by regional, city and oblast party committees. Conversation in bureau meetings have mostly centered around ideological and political support for the program.

A. Pavlovsky, secretary of the association's party committee said that "if in the ministry, we sought to introduce our measures in terms of acceptable costs and we left something out, then in the city and oblast party committees during the preparation of this question for the bureau as well as during discussions, we were stimulated to find new proposals and more effective means of influencing people".

One of the main tasks is to convince people to believe in our program of automation and the equipment that must be used to realize it.

They have tried to consider this in the association. Cadre training to bring about a qualitative jump forward in production was conducted almost parallel

to development of this program. A draft of the document was reviewed in the technical council and at a large conference of the party committee which over 300 specialists attended. They held a day for discussion of the scientific organization of labor and used this to present their ideas to the workers in shop services. The next step was the association's party and management aktiv. The program acquired the character more of a political than a management document.

The Program In Action

Whenever one speaks of new large-scale undertaking, the first question is usually "and who is going to do all of this?". The motor manufacturers have given timely thought to the structure and forms of administration. Widespread automation is still a thing of the future but in the association, there already exist an office of the chief designer of the automated control system, a computer center, NC-tool design division, industrial electronics shop and automated equipment shop. The association management is now prepared for the next stage of growth. Different services are already working on a program for the 12th five-year period.

We came to the shop where the FMS-1 system will be produced to see what the people "below" know about it. Two young people, senior foreman V. Sokhinsky and assistant director of the technical parts shop, N. Nikolayev, explained the problems that they are now having to solve in their work on FMS: they have selected and cut in half the parts list of tools that the machines will manipulate, made a list of different attachments and prepared orders for the designers. And what about the workers?

"We are learning and mastering FMS," said V. Sokolov.

We asked how this was possible with the FMS section being under design at this point.

It turned out that the famous Ivanov metal-working centers, 5 of which form the basis for the first FMS are for Volodya Sokolov no secret behind 7 seals. One of these can be used to "break in" an entire group of workers. Besides, everyone has received specialized middle education. They become familiar with the equipment and work with it to produce the same parts that they will make using automated systems. They read a lot and everyone has a list of literature that they must know by heart.

Everything visible in the shop clearly shows that the new services formed in the association are not dozing the time away. The program for the 12th five-year period has been lastingly hammered into the shop plans for organizational and technical actions of the last year of the 11th plan.

Will the structure undergo any further changes?

"It must," said the director of the division for scientific organization of labor, M. Mayzenberg. "Take the first shop in which we out together the first FMS. It should be directed by some like the section chief. There are two or three other chiefs under him that must must show up every 24 hours.

There are even more complicated administrative problems. The problems that come up moire and more often in during production require the direct involvement of representatives of different sciences. For example, on the day we visited the association, the general director was showing Vice-President of the USSR Academy of Sciences K.V. Frolov and a group of scientists around the plant. Long-term research agreements have been made with several institutes. One of these agreements involves development of an automated control system through socialist competition. In a word, science comes directly and fully into play in production.

And how is this this force to be controlled at the level of the association? The program calls for the creation of a scientific and technical center from the existing services and divisions. This is to be done in stages, starting in the form of branch and specialized laboratories which can later be reduced to one complex subdivision, a filial of a scientific and technical institute of technology and organization.

The association having its own scientific research institute? This contradicts the typical structure. This is what an employee of one of the visiting organizations wrote on the title page of the program, quoting the number and date of the relevant ministerial decree. The title page was reprinted and a month later the minister used his signature to endorse the idea that we have just mentioned. There is much evidence that carefully thought-out and substantiated readjustment of administration can always be carried out.

Let us consider one more administrative problem: the social development of workers and employees.

The following facts show how much importance the association places on worker social development. Even today, many social indicators show that the standard level of provision is high. Therefore, anyone who needs space in a kindergarten or nurseries can find it. The collective enjoys a full number of places in medical establishments such as the station hospital and clinics. Sports facilities are available to all who wish to use them.

There is a shortage of apartments and available places in children's camps and professional schools but they do not have very far to go now to meet these standards.

Thus, the chief task in solving the association's cadre problems is to stabilize the collective. This would make it easier to make qualitative changes in training workers and providing industry enough new engineers. More than 3000 pupils will learn the habits proper to modern professions in the new House of the Young Technician. Corrections have been made to the instructional programs used in the system of professional technical education. On the basis of direct agreements with large schools, the association sends its own students for courses. Recently, negotiations were begun with the Institute of Mechanical Engineering of the USSR Academy of Sciences to train designers and technicians in three-dimensional modelling.

The March plenum of the CPSU Central Committee stated that "we should and are obliged to reach the most advanced scientific and technical positions in a short time and attain a high worldwide level of worker productivity". This has guided the actions of the Andropov Motor-Building Association in its earnest realization of its own program. This year, it should be reimbursed so that the debts from the first month can be settled.

12261
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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 621.865.8

LARGE ROBOTIZED TURNING CENTERS DESCRIBED

Moscow STROITEL'NYYE I DOROZHNYYE MASHINY in Russian No 2, Feb 85 pp 19-20

[Article by engineers of the Experimental Scientific Research Institute of Metal-Cutting Machine Tools (ENIMS), V. V. Kirsanov and V. I. Tsarenko, in the "Production Technology" section: "Robotized Manufacturing Centers for Machining Shafts and Flanges"]

[Text] The introduction of numerical control (NC) machine tools has made it possible to automate machining in series and small-series production. The organization of automated production sections merged NC machine tools with automated transport systems. However, both the one and the other require the presence of an operative at the machine for low-skilled operations.

Industrial robots perform a number of auxiliary operations, such as equipment loading-unloading and control, changing cutting and auxiliary tools, controlling workpieces and parts, and cleaning of location surfaces. When used with a group of equipment they perform transfer operations between the machine tools.

Industrial robots eliminate the need for workers to perform auxiliary operations. This underscores the importance of developing robotized manufacturing centers providing for minimal human participation in production and creating conditions for two- and three-shift operation of equipment.

The principal consideration in selecting machine tools for robotized manufacturing centers is the degree of automation needed to convert them to automated operation modes without major structural readjustments. Proceeding from conditions of workpiece mounting and centering on machine tools, it was decided to start with the development of centers for machining body-of-revolution type parts, such as shafts, flanges, sleeves, etc. Fifty-eight models of machine tools were selected for incorporation in robotized manufacturing centers. They were adjusted to make them compatible with industrial robots and suitable for incorporation in automated units, e.g., for opening and closing protective guards, clamping workpieces on machine tools, electrical automation, etc.

Existing industrial robots can serve one machine (Modification I) or a group of machines (Modification II), depending on machining time. Modification I

robotized manufacturing centers are employed when machining time per part does not exceed three to five minutes; if it is longer the use of Modification II centers should be preferred. Furthermore, industrial robots are built in either floor-type or overhead-type configurations. Floor-type robots are smaller and used only in Modification I centers for handling workpieces weighing up to 10 kilograms.

Work carried out at ENIMS has resulted in the development of several robotized manufacturing centers for series and small-series production.

Automated complex for turning shafts 50-140 mm in diameter, up to 1,400 mm long, and weighing up to 160 kg (Fig. 1). The center machines external and internal end surfaces of shafts with stepped or curved configuration of different complexity, in one or several passes; it also cuts screw threads. Loading and unloading of parts on the machine tools is done by robots.

Fig. 1

The center consists of a Model MR179 centering milling machine, two Model 1B732F3 semiautomatic lathes, storage equipment, and a safety system. Productivity is up to 50,000 parts per year.

Automated center for turning shafts 300-800 mm long, weighing up to 40 kg (Fig. 2). It performs the same operations as the aforementioned center and consists of two Model 16K20T1 semiautomatic lathes, a Model SM40F280.01 industrial robot, auxiliary equipment, and a safety system. Productivity is up to 20,000 parts per year.

Automated center for finishing (grinding) a large range of shafts 15-85 mm in diameter, 350-710 mm long, and weighing up to 40 kg. The center performs external grinding of smooth and discontinuous cylindrical shaft surfaces. Steps are machined successively with the same wheel. When machining shaft

Fig. 2

necks 15-85 mm in diameter, an on-line gauging instrument can be used. The workpiece is located in centers and driven in a slider chuck. Workpieces are mounted and removed by robots.

The center consists of two Model MAZM151F2 NC cylindrical grinding machines, a Model SM40F2.80.01 industrial robot, auxiliary equipment, and a safety system. Productivity is 24,000 parts per year.

Automated manufacturing center for turning flange-type parts 40-200 mm in diameter, up to 100 mm high, and weighing up to 10 kg (Fig 3). The center is designed for turning external and internal flanges with stepped or curved configuration of different complexity in one or several passes.

It consists of a Model 1V340F30 NC turret lathe, a Model M20Ts48.01 industrial robot, a storage unit, and a safety system.

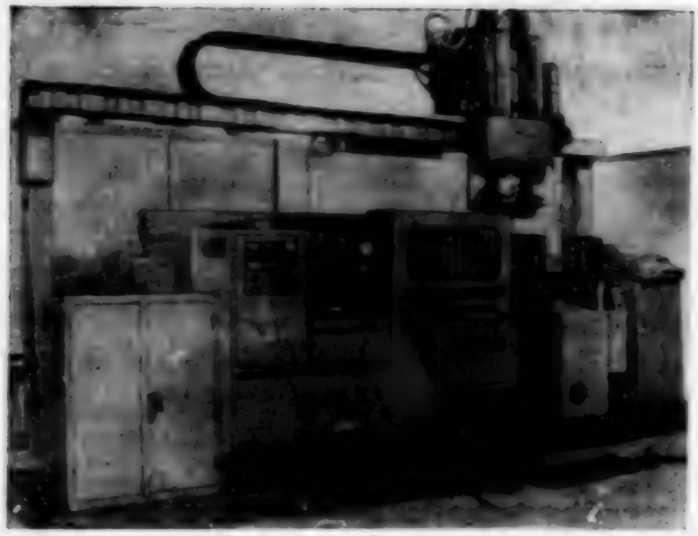


Fig. 3

Productivity of the center is up to 40,000 parts per year.

The annual economic effect gained from the use of the aforementioned robotized manufacturing centers is 8,000-158,000 rubles.

Currently the Sterlitamak High Precision Machine Tool Plant and the Mukachevo Machine Tool Plant imeni Kirov have begun full-scale production of five modifications of gantry-type industrial robots: SM40F2, M40P, SM80TsYa, UM160F2, and M20Ts. The Moscow Krasnyy Proletariy Machine Tool Production Association imeni Yefremov is introducing two models of built-in and floor-type robots, M10P and M20P.

On the basis of the aforementioned robots and serially built NC automatic lathes, a number of machine-building plants have introduced 27 standard robotized manufacturing centers, while another 26 are being readied for test operation. Fifty plants of the Ministry of the Machine Tool and Tool Building Industry are developing robotized manufacturing centers incorporating quantity-produced industrial robots and existing machine tools.

ENIMS is continuing work on designing automated machining sections for series and small-series production, better industrial robots, state-of-the art control systems, and corresponding software. This will provide a good base for the development of more sophisticated automated manufacturing centers capable of operating in conditions of so-called unmanned technology.

PHOTO CAPTIONS

1. p 2. Automated Center for Turning Shafts Weighing up to 160 kg.

2. p 3. Automated Center for Turning Shafts Weighing up to 40 kg.

3. p 4. Automated Center for Turning Flanges.

9681
CSO: 1823/176

AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 621.865.2:629.113.002

ROBOTIZED PRODUCTION SYSTEMS OBSERVED IN MODERN PLANTS

Moscow AVTOMOBILNAYA PROMYSHLENNOST in Russian No 12, Dec 84 pp 26-28

[Article by A. N. Saverina under the heading "Production and Scientific-Technical Progress": "Robots and Manipulators in Branch Enterprise Shops"]

[Text] Robots, robotized lines and sectors -- these are no longer innovations in shops at automotive plants. Understandably so, since automotive industry is highly mechanized and, to a significant extent, automated. Branch plants operate 1,340 completely automated sectors and shops, 4,500 automatic lines, 1,100 kilomoters of transport conveyors. Naturally, these also include a significant number of industrial robots and manipulators.

Thus, five robotized relay-type item assembly lines (Figure 1, following page) passed an important test at the Avtoelektroarmatura automotive electrical armature plant in Pskov. These lines (model APL-008M) are asynchronous. The automated working positions, including the finished parts monitoring and grading positions, are electronically controlled. The productivity of each line is 300 items per hour, with an annual economic impact of 560,000 rubles. Developer of the line was the NIIaftopriborov [Scientific Research and Experimental Institute of Automotive Electrical Equipment, Carburetors and Instruments].

The Moscow Automotive Plant imeni I. A. Likhachev has long operated a robot equipment sector for assembling and welding automobile door latch stops. The stops are assembled from two identical parts and are then welded by an MTP-150 industrial robot. The robot performs transport, positioning and assembly manipulations and controls the operation of the welding and auxiliary equipment. The robot manipulator is equipped with a "pincers" type of rotating and gripping mechanism.

The sector has a vibration bin with П-shaped openings for positioning the blanks. Parts incorrectly positioned are turned to the correct position by a jet of air when they reach the slots and move on to an induction sensor. Upon receiving a signal from the sensor that a part is in the initial position, the robot moves it to and places it in a welding fixture. A second part is simultaneously moving to the same fixture, where it occupies the mirror-image position. After this, the robot issues a command to turn on the welding machine.

The welded stop is removed from the fixture by a pneumatic ejector.

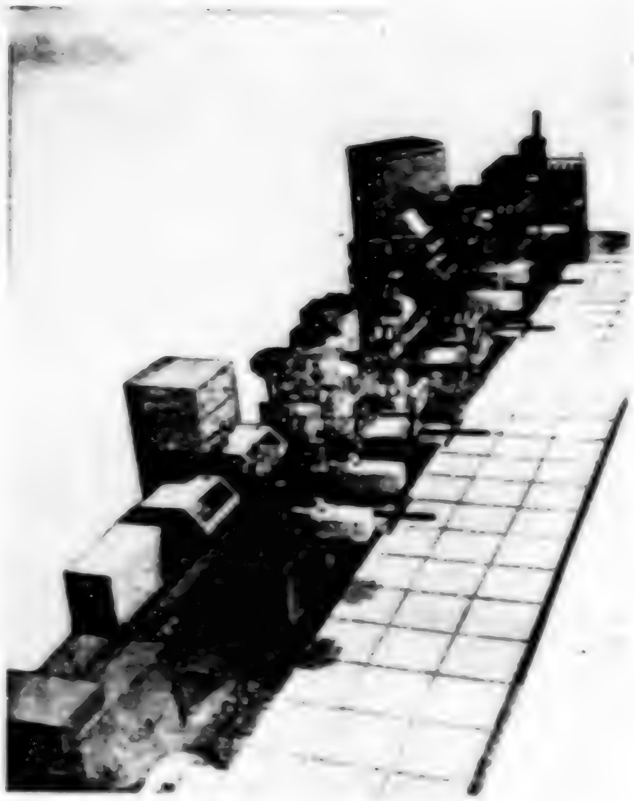


Figure 1

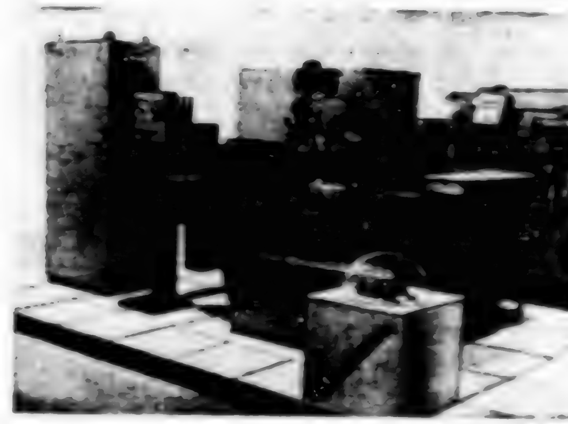


Figure 2

Figure 3

The operating cycle for manufacturing a stop is seven seconds; the capacity of the vibro-bin is 400-450 parts.

The sector operates automatically, with a manual override intended for use only for adjustments.

The MKTEIavtoprom [not further identified] has developed a robotized complex unique in our industry for assembling "shaft - housing" or "shaft - bushing" disconnects (Figure 2). It is based on manipulators assembled on a base of unitized manipulator and gripper model USB-10 modules.

In addition to the two manipulators, the complex includes transport-positioning devices, pneumatic equipment and an electroautomation system. The complex works as follows.

The parts being assembled arrive at the initial positions in trays. The first of the manipulators grasps the housing (or bushing) and sets it in a fixture; it then takes two rubber bushings, puts them on the shoulders of the housing

and turns the housing 60°. While this is going on, the second manipulator assembles the axle, bearing and washer, taking them in sequence from the trays; it then places the subassembly in the housing and removes the housing from the fixture.

The load capacity of the manipulator is 1.6 to 3.5 kg; drive is pneumatic.

What we presented above were examples, exhibited at "Avtoprom-84," of the robotization of assembly operations, among the most monotonous and fatiguing jobs done by people. But robotization serves one of the most important means of replacing manual labor in difficult, monotonous operations in general, not just in assembly. Its role in machining is also extraordinarily important. It is therefore fully understandable why the exhibit included displays illustrating the effectiveness of using industrial robots in metalworking proper.

A robotized technological complex for turning rear wheel nave parts (Figure 3, preceding page) would be a typical example. It was developed and introduced at the Kommunar automotive plant in Zaporozhye.

The complex consists of a BRIG-10-ZAZ industrial robot, a model 1A240P-6 six-spindle semiautomatic lathe and a four-tier rotating storage table. They are all controlled by one system. The robot loads, unloads, places and removes the parts. Its load capacity is 10 kg, the number of degrees of mobility is five, positioning accuracy is ±0.3 mm, gripping force is 110 kg, power consumption is 0.3 kW, productivity is 80 parts per hour. The annual economic impact of introducing the complex is 2,400 rubles.

Many other machining operations are also being robotized. For example, MP11 and MP9S manipulators, also shown at the exhibit, operate at the VAZ and other plants.

The first is used in stamping. Its load capacity is 0.2 kg, number of degrees of mobility (excluding clamp) -- three, positioning accuracy -- ±0.05 mm. The second is distinguished by its two "arms," with a load capacity of 0.5 kg each; it has six degrees of freedom, correspondingly.

Both manipulators were developed at Leningrad Polytechnical Institute and are series-produced at the VAZ. These are first-generation robots.

RB-211 robots, second-generation, were also shown at the exhibit. In particular, we saw ones manufactured in the People's Republic of Bulgaria and in use at the KrAZ, MAZ and ZIL for painting automobile cabs and bodies.

These robots can be considered self-teaching: when changing over to painting a new item, the operator guides the robot arm along the painting route one time. The information is recorded on magnetic disk in the memory of a mini-computer. All subsequent working cycles are done by the robot independently.

The load capacity of the robot is 15 kg, number of degrees of mobility -- six, memory (number of commands) -- 75, total duration of recorded programs -- 900 seconds, positioning accuracy -- ±3 mm, maximum speed of travel of painting gun -- 2 m/sec.

The robot frees four people for other work and saves 10 tons of paint materials per year.

The painting robot is only one of the items being manufactured and supplied to our branch under the long-range target program of CEMA member-nation cooperation and bilaterial long-term production specialization and cooperation programs. In addition it it, the exhibit demonstrated many other items, such as the RTK-2-DF2/TsNTs-IR-2-STs robotized technological complex for turning bearing races. This was a joint development by Soyuzpodshipnik VPO specialists and GDR machine tool manufacturers.

Figure 4.

The complex permits machining bearing parts up to 250 mm in diameter. It consists of an IR-2-STs industrial robot, two NC DF2/TsNTs machine tools and two rotating SPR-F cadence bins. The robot has hydraulic drive and electronic control, can operate shift-long, performs loading jobs under conditions hazardous to human health, and increases equipment productivity 10- to 12-fold.

This, the Avtoprom-84 exhibit showed that questions of robotizing production are being given the most intense scrutiny in automotive manufacturing industry. Branch enterprises are using robots and robot equipment complexes developed by plants of the Minstankoprom [Ministry of Machine Tool and Tool Building Industry], CEMA member-nations and enterprises of its own ministry. It is therefore quite obvious that the tasks planned for the 11th Five-Year Plan -- introduction of more than 2,000 industrial robots and the associated freeing of more than 3,500 people in basic production for other work -- will be successfully carried out.

11052
CSO: 1823/184

AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 69.002.5+625.7.08+628.4.002.5]:621.9.06-52

KALININ EXCAVATOR PLANT IMPLEMENTS FLEXIBLE PRODUCTION SYSTEM

Moscow STROITEL'NYYE I DOROZHNYYE MASHINY in Russian No 4, Apr 85 pp 6-7

[Article by engineers G. I. Krutenko and V. D. Prokof'yev, VPTIstroydormash NPO, under the rubric "Production Technology": "Problems of Branch Development of Flexible Production Systems"]

[Text] Lowering output net cost, accelerating labor productivity growth, an increased demand for updated goods on the world market and, consequently, reduced time for mastering their production -- such are the basic demands being made today on industrial production. Comprehensive production automation is a decisive factor in meeting these demands. This applies most particularly to machinebuilding, where 75-80 percent of the output being released is accounted for by series and small-series production. The methods and means used to automate mass production turn out to be unsuitable for production of this nature. Under these conditions, the creation of expensive, maximally automated, highly productive means of production can, under these conditions, turn out to be inefficient, inasmuch as acceptable reimbursement periods will not be ensured.

In series and small-series production, opportunities for automating technological processes have been expanded with the introduction of NPC machine tools, robots and microprocessor equipment into industry. However, domestic and foreign experience shows that the use of individual NPC machine tools and even of machine tools equipped with robots does not always ensure the desired results in connection with the fact that they are operated under traditional organizational conditions, and given their high cost and considerable expenditures on servicing. Flexible production systems (GPS) currently being developed for series and small-series production ensure a resolution of the above-mentioned problems. GPS generally consist of several automatic or semiautomatic pieces of equipment connected by an automatic system for storing and moving blanks (tools) so as to provide an opportunity for simultaneous processing of different blanks which can be traveling different routes through different work sectors (machine tools). In this regard, GPS must possess a potential for producing items in a random products list given set specifications.

Overall control of the processing, moving and storage systems requires a large number of error-free decisions quickly following one another, so it is necessary in a majority of cases to use a computer as the production process control unit.

Thus, the basic requirements made of GPS are a high level of production organization, automation and management, and high productivity and flexibility.

In accordance with the principles of group technology, the systems being developed can be divided into GPS designed to manufacture housings, those to manufacture rotating-body parts and those to manufacture flat parts.

According to statistical data, the largest number of items in machinebuilding are rotating-body parts and the most labor-intensive are housings. However, not every enterprise has a production volume sufficient to develop an expensive GPS for processing housings, while practically every enterprise has facilities to produce rotating-body parts.

As a consequence, the most common GPS are those for machining rotating-body parts, followed by those for machining housings.

GPS for housings consist, depending on production volume, of 3-10 pieces of basic technological equipment (as, for example, "processing center" machine tools with large feeder bins holding up to 140 units) for tools, but rotating-body GPS can contain up to 100 or more pieces of technological equipment, this currently being limited only by the extent and amount of capital expenditures. Moreover, GPS introduction on the scale of a large sector or shop of an existing production facility is a complex organizational problem and is not within the means of every enterprise. However, the economic effectiveness of GPS is directly dependent on the amount of basic technological equipment (production volume) included in it, since expenditures on computer equipment, planning, production organization and preparation, and system maintenance change little as the GPS composition increases.

It should be noted that there are thus far no methods for calculating the economic effectiveness of GPS introduction, and the methods being used by developers do not take into account the positive factors of flexible technology when changing over to the release of new items. Let us also note that the existing system of material incentives does not ensure developer interest in creating GPS. As we know, the levels of incentives are directly dependent on the economic impact during creation of a facility as well, and for GPS, this period is at least five years, with a large number of participants in its development and introduction. During this time, working on a "narrow-project" [melkotem'ye] basis, it is possible to introduce a number of facilities with an overall effectiveness exceeding the effectiveness of introducing the GPS, and consequently with greater incentives to their developers. As a result, it is not rate for specialists to be extremely reluctant to take part in GPS development.

Whereas processing-center machine tools are quite suitable for machining housings as part of GPS, the lathe-group machine tools currently in production for machining rotating bodies do not satisfy basic GPS requirements, as they do not, first of all, ensure joint operation with industrial robots. The machine tool + robot module must be the main constituent technological cell when developing GPS for processing rotating-body parts. In order that the GPS module operate for long periods (an entire shift, for example) without human participation, it must be equipped, in addition to devices coupling the module control system and the central computer, with additional devices performing the functions of an

operator (device for monitoring tool condition and wear and various diagnostic units) and, in a number of instances, an adaptive control device. All these devices must function in conjunction with the machine tool and robot NPC system.

Ensuring the interaction of the robot storage-positioning devices in the module and the GPS transport-transfer devices is a most important task in freeing people from the difficult, monotonous labor involved in transferring blanks from the transport-transfer devices to and from the robot storage-positioning devices. Unfortunately, the modules currently being produced do not satisfy these requirements.

One other problem is that of developing standard transport-transfer devices (ATSS [automated transport-storage systems], robot cars, automatic rail carts, and so forth).

Finally, there is the problem of creating a GPS control system complex of equipment with standard control program packs. Moreover, there are quite a few seemingly minor, but important, tasks such as the development of systems for diagnosing the status of equipment and control programs, monitoring the accuracy of the machining and the condition of the cutting tool, the lubricant and coolant feeds, shavings removal, and improving the reliability of all GPS links, from machine tool and computer to cutting tool.

GPS must produce parts in finished form, that is, they must operate in a closed parts manufacturing cycle; otherwise, there are interruptions in the automatic feed of the blanks, in data flow on the status of the machining and, consequently, the planning and actual status of current production are not subject to performance recording by machine. This signifies that GPS must include, along with NPC machine tools, other machines to perform the full cycle of parts manufacture. The selection of parts and equipment must ensure a maximum load on the machine tools.

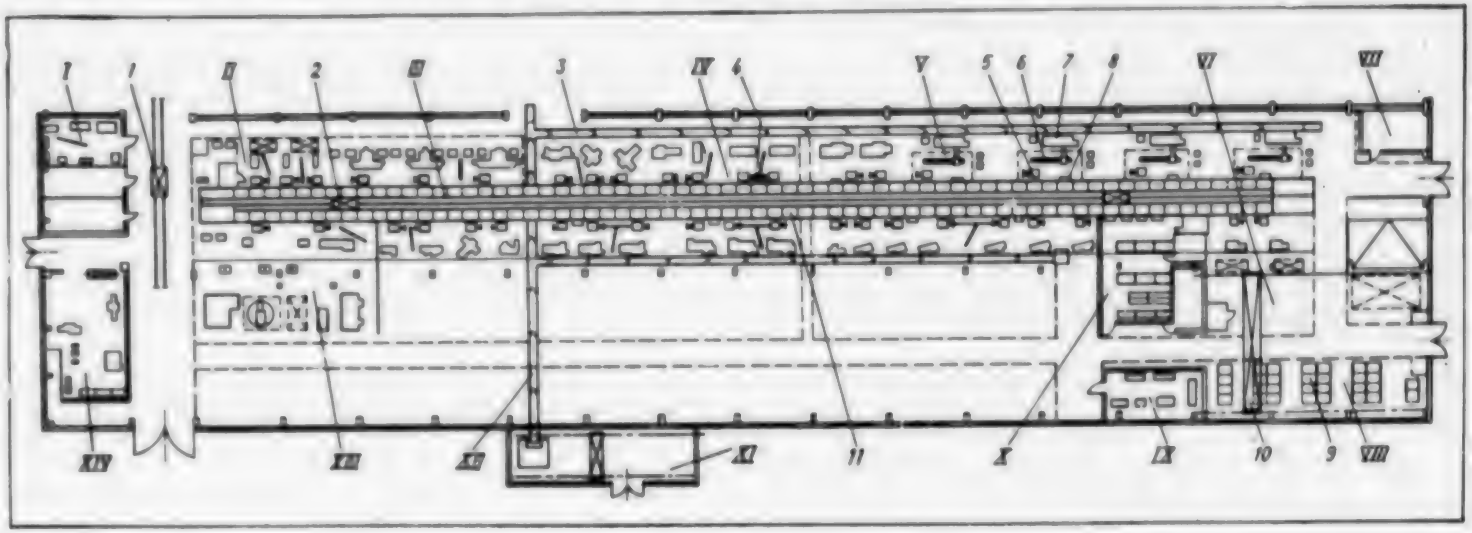
Success in completing GPS development work depends on plant preparedness to put them into operation. Here, we should first of all note the interest of plant workers, and foremost of the plant leadership, and the availability at the plant of specialists with experience in operating NPC machine tools and computer equipment; without this, GPS introduction is not possible.

Branch GPS development began with the organization of ARTK MO (automated, robotized technological machining complex) sectors for processing excavator shafts and axles at the Kalinin Excavator Plant.

Currently, all the planning work, in which several technological planning organizations and the Kalinin Excavator Plant participated, is complete. Nonstandard equipment is being manufactured at a number of Soyuzstroymashavtomatizatsiya VPO plants.

The ARTK MO (see drawing, following page) is designed to produce excavator shafts and axles (up to 1,100 mm long and weighing up to 62 kg), 185,000 per year, with a full manufacturing cycle. The complex includes 35 machine tools of various types (lathes, gear cutters, grinders and others) and a heat-treating sector. Overall control of the complex is effected by a computer-based control

Automated, Robotized Technological Machining Complex (ARTK MO) for Shafts and Axles



Key:

I.	Precision measurement room	1.	Transfer cart
II.	Monitoring station	2.	Transport manipulator
III.	Automated transport-storage system	3.	Shavings sweeping conveyor
IV.	Machining department	4.	Pivot-balance manipulator
V.	Robotized technological module	5.	Stationary manipulator
VI.	Blank batching department	6.	RB-232T robot
VII.	Troubleshooting room	7.	1B732F3 machine tool
VIII.	Blank storage	8.	Technological supply cell
IX.	Centralized tool sharpening sector	9.	Blank storage shelving
X.	Technological supply department and tool distribution storage	10.	Stacking crane
XI.	Shavings collection department	11.	Automated transport-storage system shelving
XII.	Shavings sweeping system		
XIII.	Heat treatment sector		
XIV.	Equipment repair sector		

complex (UVK). The main technological cell of the complex is a robotized technological module (RTM) based on the 1B732F3 machine tool and RB-232T robot, produced by the NRB [People's Republic of Bulgaria].

The role of interoperational transport and storage of interoperational stocks is performed by an automated transport-storage system (ATNS). The ATNS is a two-tier shelving unit serviced by two transport manipulators; the shelfing cells are equipped with devices for feeding (receiving) blanks (semifinished products) and supplying tools to the workstation, with stationary manipulators for the blanks, and with a receive-supply device for fittings. Blanks are also supplied to the workstation, in the ATNS system, in special pallet-packs in a precise position so that they can be grasped by the robot's grippers. The blank pallets are fed to the ATNS according to a schedule plan through the centering-milling machine workstations of the blank batching department. Technological supply keeps the lots of blanks in complete sets, on separate pallets, in each operation and feeds them to the ATNS through receive-supply devices in the technological supply department. The pallets and blanks are fed to the workstations by transport manipulators and are fed directly to the machine tools by stationary manipulators. After undergoing all operations in the technological process, the finished parts emerge at a monitoring station where they receive final acceptance and are placed into factory packing for shipment for assembly. The empty pallets are returned to the ATNS to make up new complete lots of blanks.

11052
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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

BRIEFS

AUTOMATED PRODUCTION SYSTEM--Automated production of body parts for the machine-building industry has been started at the "October Banner" Association in Leningrad. Here, all processes are performed by robots and automated machinery which are "directed" by computer. The complex was created in accordance with the "Intensification 90" regional program. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 18, May 85 p 5] 12261

CSO: 1823/148

ROBOTICS

UDC 658.5

ROBOTIZED MACHINING SYSTEMS DEVELOPED AT GOMEL INSTITUTE

Moscow TRAKTORY I SELKHOZMASHINY in Russian No 4, Apr 85 p 54

[Article by N.N. Gulyayev, engineer, Gomel Design, Technological and Experimental Institute: "The Gomel Design, Technological and Experimental Institute in the struggle to improve the technical quality of technology"]

[Text] Some decisions made by the party and government have very clearly stated the main task of the machine-building industry: the introduction and assimilation in industry of high-output equipment that can increase labor productivity, lower material and energy costs and increase domestic demand for its products by creating highly efficient systems of machinery and equipment. During the 11th Five-Year Plan, the Ministry of Livestock Machinery's plants should increase their output of machinery used in livestock and animal husbandry 150 percent over that of 1980. This places certain demands on the level of technology and on the planning for technical reequipment of the ministry's plants which is being done by the Gomel Design, Technical and Experimental Institute which is presently celebrating its 10th anniversary.

On the basis of the results of advanced experiments conducted within the machine-building branches of the livestock industry, the peculiarities of producing such machinery and the scientific and the technical potential of plants and organizations in this branch, the basic trends for improvement of the technical level of machine-working industry can be seen in:

-- the use of NC machines for single- and small-series production;

-- for series production, the use of NC machines and separate "robot/NC-machine" modules, robotic complexes made from specialized and aggregate machines and finally the creation of experimental FMS;

-- in large-series and mass production, the use of readjustable automated lines and technological lines formed from specialized and aggregate machines.

In view of the fact that the use of manipulators and industrial robots has become one of the basic trends of automation, we must concentrate on employing these devices in machine tooling and cold sheet-metal stamping.

For the Gomselmash Production Association, the institute has developed and introduced 5 robotic lines, two robotic complexes and one robotic section for tool-working mechanical parts. Aside from this, two robotic stamping sections have also been developed. These sections, complexes and lines use robots and manipulators.

The technological sophistication of the equipment has been considerably enhanced by the use of 14 different patented inventions.

The introduction of robotic devices to production has replaced about 30 workers.

Robotic complexes based on RPLSh-1 (or Cyclone) robots are presently being built at the Lyuberentsk Agricultural Machinery Plant imeni Ukhtomsky, at the Frunze Agricultural Machinery Plant and the Syzran Agricultural Machinery Plant.

The institute is designing robotic lines and complexes for the Pargolovo Machine-Building Plant and the Neris Production Association in Lithuania.

In building robotic sections, it is necessary to remember that the programmable machines now available are, as a rule, not fully operable by industrial robots and this means that the following problems must be solved:

-- the industrial-robot system must be connected to a machine control system;

-- the clamping of parts to the chuck (for flanges), gripping of the end of the part with a draw bar (for shafts) and attachment and clamping to the table must be done automatically;

-- automatic movement of protective shields;

-- creation of highly-versatile chucks to reduce time spent on machine adjustment.

Robotic lines, section and complexes will only be able to perform the tasks for which they are designed if these problems can be solved.

The agricultural machinery produced by the branch has a high number of complicated parts that require surface finishing after heat treatment and before galvanization. This is usually done on vibration-grinding and shotblast machines that are relatively slow.

Institute specialists have designed and patented a device for blast grinding of the small complicated parts used to build the KSK-100 combine. It can work 85 kg of parts per hour and this is 5-10 times faster than the aforementioned machines.

The savings achieved at the Gomselmash Production Association by the introduction of this machine was 5,700 rubles. In order to increase worker

productivity and material economy and to improve the quality and technical sophistication of cold sheet-metal stamping, the institute has developed and introduced at Gomselmash some typical technological processes for cutting thick rolled sheet-metal into 43 parts and for longitudinally cutting rolled steel on an automated line into 58 parts. The savings produced by these methods amounted to nearly 136,000 rubles.

In speaking of the new technology already introduced to plants of this branch of industry, we must also mention the problems that the institute is presently working to solve.

During its work on the research and development of a new technology for the manufacture of machine parts from pipes, the institute created a technological process and stamps used to pierce holes into right-angle pipes. These have been built and operated at the Gomselmash Production Association and were responsible for a 950-percent increase in labor productivity. Unquestionably, this method will be used at many other plants in this branch of industry.

Research is being conducted on the production and use of RK [not further identified] profile joints instead of splined or keyed joints in manufactured articles. Such a joint produces axle-and-bushing joint cross sections that are stronger than those of splined or keyed joints.

A technological process for making retaining rings from wire instead of sheet metal is also being studied. Thanks to this method of manufacturing these rings, the metal usage factor was increased from 0.16 to 0.98 while labor productivity rose 300 percent.

In order to solve the most important tasks in increasing the technical level of metal working operations, the institute is introducing:

-- a technology that uses preheating to work heat-resistant and difficult materials;

-- equipment for cold metal working;

-- electrophysical methods of metal working;

-- flexible production systems that use NC-machine modules equipped with a computer-controlled transport system;

-- new cutting materials and tools;

-- tool adjustment within the machine during parts manufacture by automatic and semiautomatic machinery;

-- a computerized system of standard, adjustable equipment.

The institute regards the solving of these problems as its chief task for the coming five-year period.

12261
CSO: 1823/151

ROBOTICS

UDC 621.865.8:629.12

TYUMEN SHIPBUILDER SOLVES INITIAL ROBOTIZATION PROBLEMS

Leningrad SUDOSTROYENIYE in Russian No 5, May 85 pp 55-57

[Article by Yu. A. Fomin under the heading "Shipbuilding and Machinebuilding Technology": "Introducing Robot Equipment at Tyumen Shipbuilding Plant"]

[Text] The "Basic Directions of USSR Economic and Social Development During 1981-1985 and Up To 1990" anticipate the extensive application of industrial robots and built-in automatic control systems using microprocessors and microcomputers, and the development of automated shops and plants.

Tyumen Shipbuilding Plant attaches top priority to mechanizing and automating production processes. Plant engineering-technical workers are constantly studying technical innovations and developing technological processes, fittings and nonstandard equipment corresponding to the modern level of production development. Industrial robots, as a new direction in the development of production equipment, were no exception. In order to ensure their introduction and operation, a robot equipment technological design bureau was created at the plant. The experience accumulated at shipbuilding enterprises and other branches was used in developing the appropriate documentation.

Not all went smoothly in the initial stages of introducing industrial robots. The plant's first robot-equipment complex (RTK) was designed to shape clamp parts (Figure 1, following page). It began operating in August 1981. However, operation of the complex demonstrated that certain features of the part being manufactured had not been taken into account during its development.

But development of a second complex, one to manufacture a special irregularly-shaped part, was crowned with success (Figure 2, following page). The RTK automated the operation of making holes and bending metal strip. Introduction of the complex enabled us to free two female workers from monotonous, fatiguing manual labor and to ensure the smooth release of a rather complex part.

However, this RTK as well was not free of shortcomings. As before, the operation of loading the bins of the feed device was laborious, and it turned out to be impossible to load them when the manipulator was operating. Further, the size of the bin prevented the RTK from operating more than 20 minutes without stopping. In addition, the blank sheets sometimes stuck together if there was abundant lubrication.

Figure 1. Diagram of an RTK for Shaping Clamp Parts

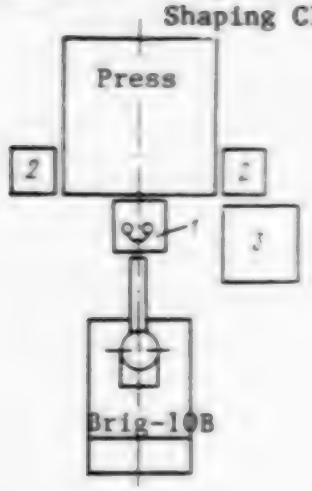
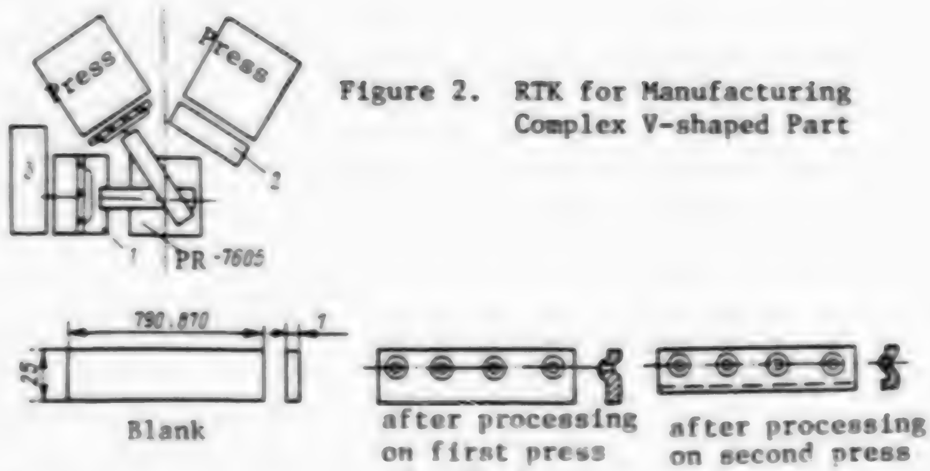


Figure 2. RTK for Manufacturing Complex V-shaped Part



Key:
1. Feed
2, 3. Packing for finished parts and blanks, respectively

1. Feed
2, 3. Packing for finished parts and blanks, respectively

An automatic device for feeding blanks to the bin after they have been cut by guillotine and a pneumatic device for blowing the blank into the feed hopper are being developed for the purpose of improving this RTK.

The next three complexes were introduced as a single group after the robotized sector was created (Figure 3, following page). One feature of this sector is that all three RTK can, when necessary, operate either as part of a line or individually. This permits the manufacture of parts requiring from one to three technological operations.

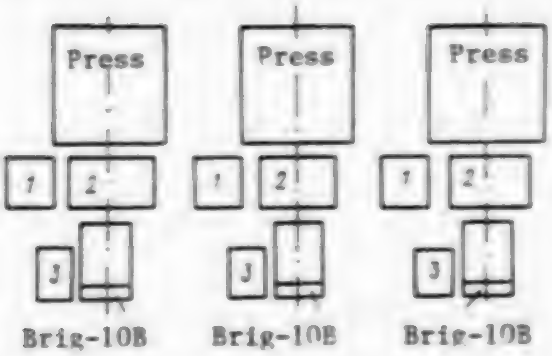
When the RTK is operated as part of a line, the blank is transferred from one complex to another across transfer tables.

We especially need to note that the plant decided to systematically switch the manufacture of mass-produced parts, including consumer goods, over to automatic lines. Let us examine the operating principle of the initial such lines.

The automatic line for manufacturing pipe parts (Figure 4, following page) was designed to perform several technological operations: cutting off blanks to the necessary length (22-mm diameter: lengths of 1, 1.2, 1.4, 1.6, 1.8, 2, 2.2, 2.4 and 2.6 m), processing both butt ends, stamping, rough and fine polishing.

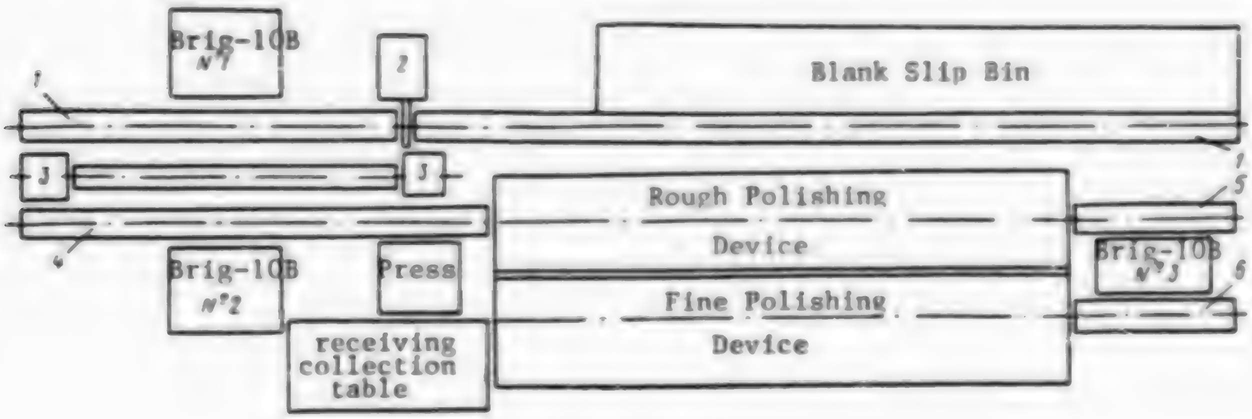
The line operates as follows. A worker takes a pipe 5-6 m long from the bin and places it into a 50-pipe slip-bin, ensuring automatic operation of the line without additional loading for a period of four hours. From the bin, the pipe is fed by conveyor belt (1) at a speed of 75 mm/sec to a special stop. When

Figure 3. Sector Consisting of Three Robot Equipment Complexes



Key:
1. Feed
2, 3. Packing for finished parts and blanks, respectively

Figure 4. Automatic Line for Manufacturing Pipe Parts

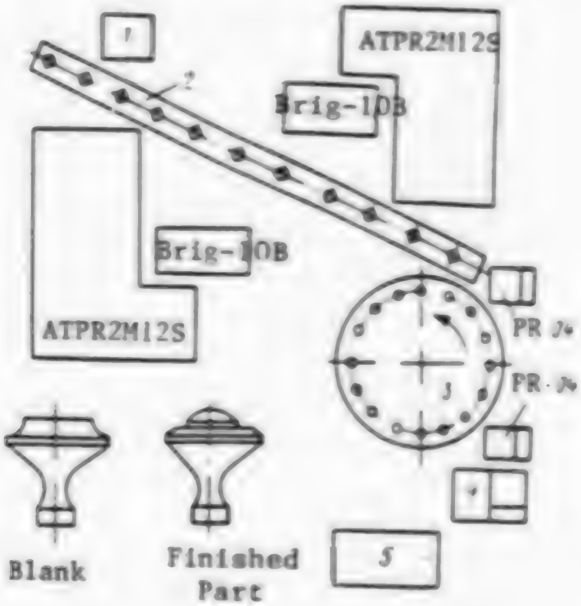


Key:
1. Conveyor belt
2. Cutoff device
3. Butt facing installation
4, 5, 6. Conveyor belts

the sensor at the stop is touched, the drive of conveyor belt (1) is switched on and the Brig-10B robot begins operating. The pipe is clamped in the cutoff device (2) and the robot gripper grasps it in the center. The pipe is cut, after which the Brig-10B robot moves the blank to the butt-facing installation (3). In this position, the operating program of a second Brig-10B robot is switched on. This robot feeds the pipe with the processed butt ends to a press for stamping and then places it on a nondrive conveyor belt (4). The pipe then moves at a speed of 63 mm/sec by conveyor belt to the rough polishing section and is then advanced by nondrive conveyor belt (5). When a pipe is on this conveyor, a third Brig-10B robot begins operating. It transfers the blank to a drive conveyor belt which feeds the blank at a speed of 63 mm/sec to the final operation, fine polishing, and then on to the receiving collection table.

Introduction of this automatic line has enabled us to reduce the labor intensiveness of manufacturing pipe parts by 3,600 norm-hours per year.

Figure 5. Automatic Pushbutton Processing Line



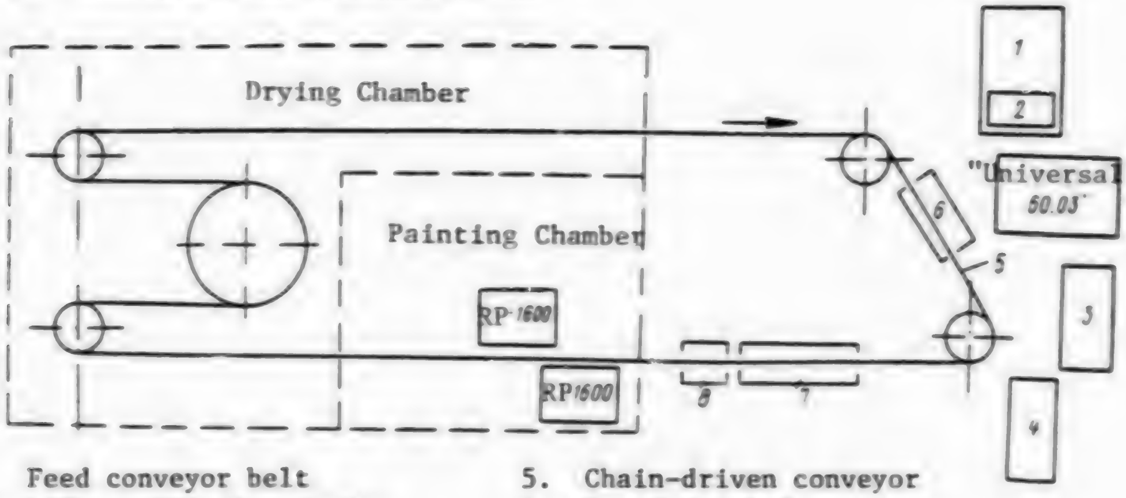
Key:

1. Packing for blanks
2. Collector conveyor belt
3. Polishing installation
4. Positioning unit
5. Control panel

A second automatic line manufactures pushbuttons (Figure 5). It turns and polishes the pushbuttons. The equipment operating principle is as follows. A worker fills the recesses in collector conveyor belt (2) with blanks, which are fed to two lathe RTK. There, Brig-10B industrial robots take the blanks off the conveyor and set them in the holding devices of the semiautomatic ATPR2MI2S lathes, which process the contoured portion of the pushbutton caps. These same robots place the processed parts into free spoet on the conveyor belt. The pushbuttons are then fed by conveyor to the polishing RTK. A PR-04 robot takes them from the conveyor and sets them on the table of polishing device (3). The table is rotated one step every 17 seconds. Polishing is done by two disks, one felt disk with a special paste (rough polishing) and another knit disk (fine polishing). After this operation is complete, a second PR-04 robot transfers the pushbuttons from the table to the casettes of positioning device (4), with a capacity of 100 parts. The economic impact of introducing this automatic line is 20,000 rubles per year.

The third automatic line is for painting rectangular metal panels approximately 0.9 x 1.8 m in size (see Figure 6, following page). At the start of the line, a worker uses a crane jib to set batches of panels (18 panels per batch) onto conveyor belt (1) for painting. The conveyor belt automatically feeds these batches to a lift-positioning device (2) which places the top panel in the

Figure 6. Automatic Panel Painting Line



Key:

1. Feed conveyor belt
2. Lift-positioning device
3. Receiving container
4. Exchange container
5. Chain-driven conveyor
6. Receiving bed
7. Washing chamber
8. Drying chamber

batch in working position for the gripper of a Universal 60.03 industrial robot. This robot uses two programs: one is for taking the panel from the lift-positioning device (2) and hanging it on a chain-driven conveyor (5); the other is for taking the painted panel off the receiving bed (6) and setting it in container (3). After container (3) is full, it is replaced by container (4). The panel on conveyor belt (5) moves through washing (7) and drying (8) chambers at 1.2 m/min to the painting chamber. Here, RP-1600 manipulators automatically paint the panels. Paint is not sprayed if no panels are present. The manipulators are equipped with automatic blow-through devices which ensures even coating without human participation. After painting, the panels pass through the drying chamber, where they are held for 45 minutes at 80°C. Release of this line has enabled us to free two workers from hazardous operations and to substantially improve working conditions as a whole.

These are some examples of the practical use of industrial robots in production. The introduction of robot equipment and other means of automation at the plant continues.

11052
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FRUSTRATIONS WITH AUTOMATED PRODUCTION MANAGEMENT SYSTEMS

Kiev RABOCHAYA GAZETA in Russian 1 Dec 84 p 2

[Article by A. Kovtun, special RABOCHAYA GAZETA correspondent, and S. Serdyuk, associate of the Kiev Institute of Automatics, in the column "The Productive Power Of Science": "Sensors of Conservatism: Why the Automated Production Management Systems at the Krivoy Rog Metallurgical Combine imeni V. I. Lenin Are Not Bringing the Expected Returns"]

[Text] Krivoy Rog--Ten years ago, a computer center was put into operation at Krivorozhstal' [Krivoy Rog Metallurgical Combine imeni V. I. Lenin]. Several modern computers, occupying 4200 square meters of floor space, were installed. At that time, few enterprises had such an equipment base. The center's excellent equipment enabled the combine to develop the first phase of an AMS: a plant automated management system. Over the years, the system's functions have been expanded, methods of analyzing the enterprise's operation have been improved, and the computer equipment was upgraded. Today, the AMS hardware base includes 29 late-model computers. Eighteen automated production management systems (APMS) have been put into operation, and the functions of existing systems have been greatly expanded. The combine now has 14 operating APMS subsystems and 26 automated process control systems (APCS), and a dispatcher management system for the combine.

These data were taken from an official document. Here is another document: director's order No 359, dated 29 May 1984:

"The report data count the following inoperative systems as operating: the shearing AMS on the 150-ton flying shears of the No 2 blooming mill; the pattern-cutting AMS on the No 3 blooming mill's NZS [expansion unknown] and the product-information tracking system on the No 3 blooming mill.

"In the No 2 converter shop, 465,000 R were spent on developing an APCS. Because of inefficient use and operation of the dispatcher control system, no economic savings have yet been obtained. By the end of the 5-year plan, the savings are expected to be 113,000 R, instead of the planned 200,000 R."

What is happening? Why did the combine, which is justifiably proud of its friendship with science, have to issue an order in which the director

basically admits that insufficient attention has been given to implementing AMS's at Krivorozhstal'?

It will be easier to understand this if we first determine the sphere of problems connected with automation. First of all, we should not be afraid of the rather naive question: what is an AMS? Without delving into technical details, an AMS can be described as a program of measures aimed at optimizing production processes. It includes the gathering of initial and operating data and the analysis of these data by computer, using the pertinent programs. The computer solves the task and the machine outputs recommendations for production personnel.

One of the main and most complex tasks in metallurgy is how to obtain on-line data while the processes are occurring. It is far from always possible to "look" into a molten mass of metal. Scientists have not yet developed the necessary sensors that can get the needed information without pouring steel from the converter.

The second problem is executing the computer commands. As a rule, even where an AMS is working well, the operating personnel do not always follow its recommendations. For instance, in a difficult situation, the computer might propose shutting down one of the converters and making up for the lost output by improving the operation of the remaining converters. But no shop chief will ever do that! Man, as we have seen, remains the main link in the automated system.

But even on the level when an AMS operates mainly as a data processing system, the use of a computer ensures highly efficient production. After all, modern metallurgical production is very complex. If there was a shutdown in one of the links, say in the sintering mill, then this will be felt several days later in the rolling shop. A specialist is not able to foresee all the complications and provide the right recommendations. Only an AMS can do this. Back in the mid-1960's, work was done to develop AMS's in which the means for gathering, transmitting, and processing information would be used for direct control. One such AMS, the automatic dispatcher control system for converter melting at Krivorozhstal', was developed by the Kiev Institute of Automatics.

This was one of the systems mentioned in the director's order quoted earlier. The system operates in the following manner: the computer keeps track of the operation of all six converters and generates tabular data for each heat, which includes the duration of the separate periods and the "hot time." If an interruption occurs, the system dispassionately determines all the technological, equipment, and organizational mistakes.

The dispatcher control AMS actually just reflects the work of specialists and the entire shop collective. A similar system, although not on the same scale, is successfully operating at Azovstal', helping to improve the productivity of the steel melting equipment.

The situation is somewhat paradoxical in the No 2 converter shop at Krivorozhstal'. Judge for yourself: the shop operates stably and, since

the beginning of the year, its collective has produced over 11,000 above-plan tons of steel. This production facility is comparatively new; therefore, they didn't have to jam the automatic controls into old facilities, a task which is often fraught with compromise solutions. And the shop foreman, Grigoriy Lukich Shapoval, is an experienced, knowledgeable specialist. However, the AMS, as the director noted in his order, is not producing any savings. In other words, the achievements of the shop do not depend on the computers. Why?

In October 1982, G. A. Shapoval signed the AMS implementation document.

"Now," explained I. G. Grishtar', chief of the computer center of the No 2 oxygen converter shop, "Grigoriy Lukich stated: I will write down that 10,000 R of economic savings were obtained from the implementation of the AMS."

Isn't this strange? It's as if the concept of economic savings is so flexible that it can be either increased or decreased.

The deputy chief of the production automation department, Mikhail Nikolayevich Bayraka, explained:

"What shop chief will determine the economic savings for a system he doesn't use?"

But why isn't it used? Perhaps the system isn't perfected?

"There are a few shortcomings. The problem here is that the sensors which were to have provided on-line information have still not been developed. They have to use indirect characteristics of the metallurgical process, such as analysis of exhaust gases and the carbon burn-out rate..."

When starting to implement the system, the Krivorozhstal' specialists were well aware of this. But then it was noted that the automatic dispatcher control system will help solve other problems. It disciplines the personnel and forces them to more carefully use each working minute.

"The usefulness of the AMS is obvious to the unaided eye," says the chief of the No 1 converter block, A. D. Sapsay. "If the system is down, it's much more difficult work. The load is greater. You have to keep a large amount of data in your head: which converter needs a hot-metal car at what time; where is a slag ladle needed etc."

Askol'd Dmitriyevich himself not only has high hopes for the system, but is trying to work with the machine. Earlier this year he proposed an improvement in the AMS. One more task was developed for the computer: now, electronic devices group the orders according to steel grades. This work used to be done by a specific worker, the sorter. A. D. Sapsay "advised" them to enter into electronic memory the control numbers for using reducing agents and ferroalloys; it then was no longer necessary to keep on a person specifically for this job.

At one time, A. D. Sapsay tried to convince the shop chief of the necessity of more widely using their computer's capabilities. The discussion brought about no change.

Therefore, the problem is not so much in the complexities of implementation as it is in the so-called psychological factor. More precisely, it's in the unwillingness of G. L. Shapoval to take on the task of automation.

"And why?" he says. "After all, the shop is fulfilling and even overfulfilling its plan... In addition, the present AMS's have not been perfected."

This is an absolutely improper position! It smacks of the usual conservatism and lack of desire to take on the complex problems of implementing the latest equipment. Hiding behind reassuring indicators, G. L. Shapoval simply does not want any extra worries, and is silent about the fact that these indicators could be improved through using the capabilities of the latest AMS's, as was confirmed by specialists at a similar production facility, Azovstal' Combine.

As far as imperfections in the system, then, of course the engineering-production personnel themselves must help the scientists develop the necessary sensors for gathering primary information. This job is indeed complex. But it will be difficult to see through to the finish, we are convinced, because other "sensors" show a too-high level of conservatism. And if not the shop chief, then who should be interested in technical progress?

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